AVIATION WEEK

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January 27, 1958 75 cents

USAF School Seeks Answer to Space Survival

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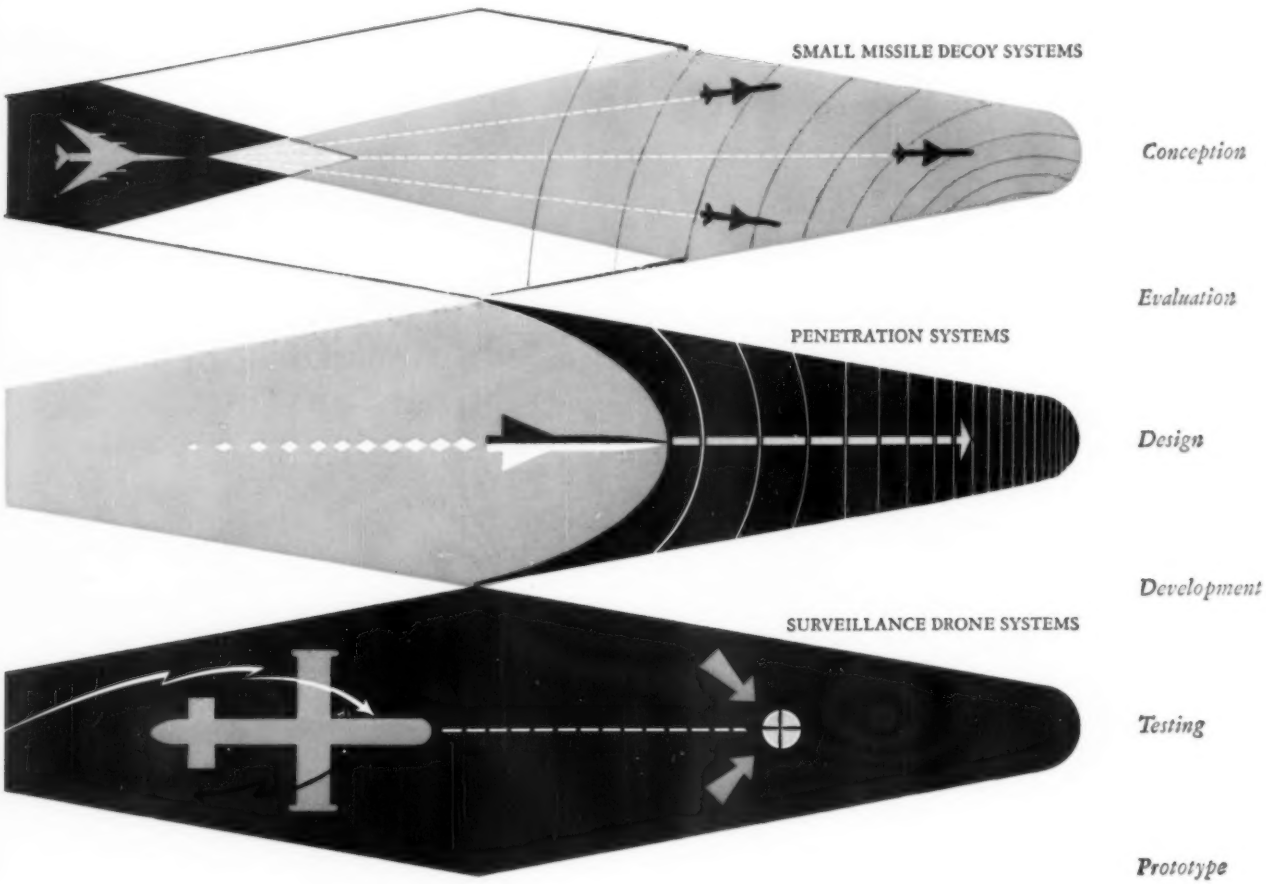

Rheem Aircraft is a division of the Worldwide Rheem Manufacturing Company which operates 18 plants in the United States . . . and with its associated and licensed companies operates 17 plants in 11 countries. These extensive facilities coupled with Rheem's years of aircraft production experience provide the capability for the quantity production of drone and missile systems.

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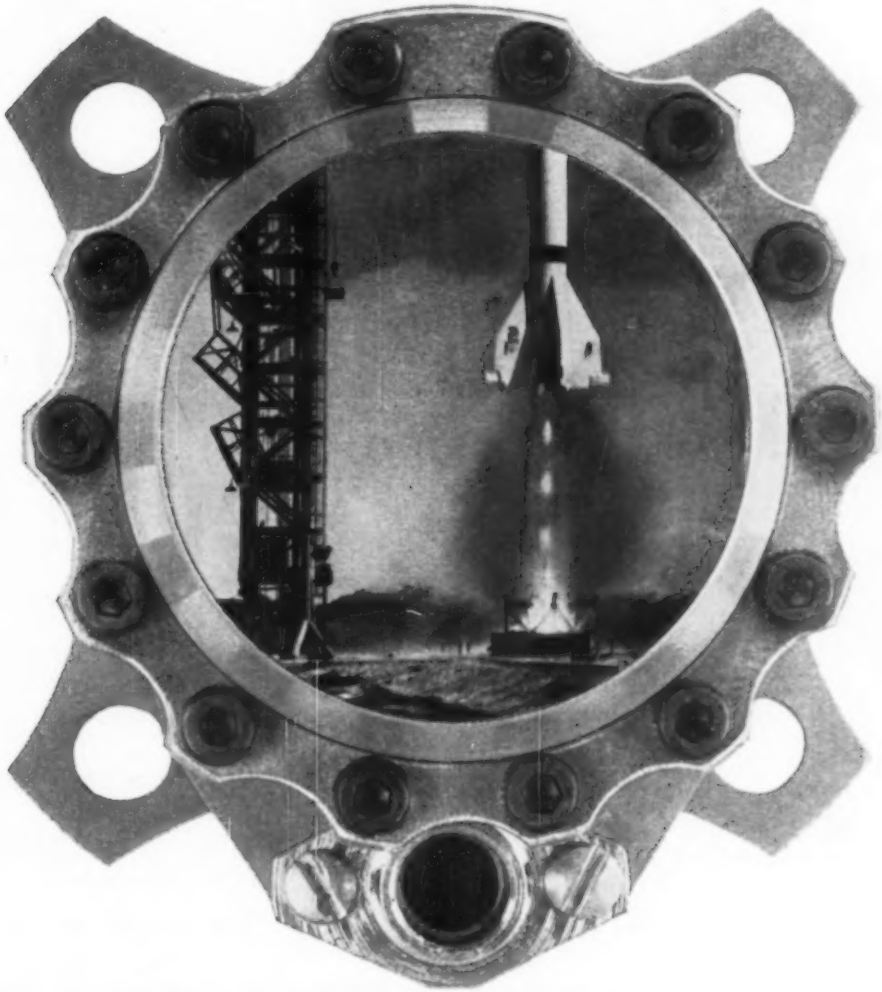
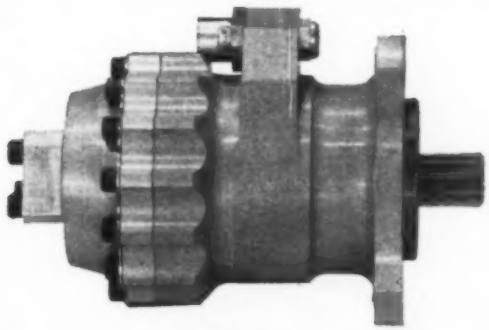


NOW you can order missile hydraulic pumps from HYDRO-AIRE



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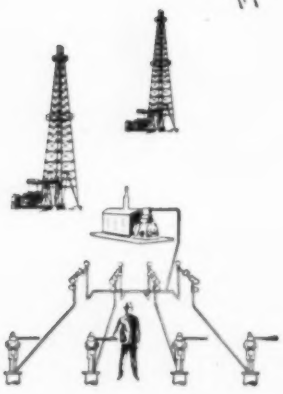

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AVIATION CALENDAR

Jan. 27-30—26th Annual Meeting, Institute of the Aeronautical Sciences, Sheraton-Astor Hotel, New York City. Honors Night Dinner, Jan. 28.

Jan. 27-30—Plant Maintenance & Engineering Show, International Amphitheatre, Chicago.

Jan. 27-31—Engineering Institute's Time Study Appreciation Course, University of Wisconsin, University Extension Div., Madison 6, Wis.

Jan. 28-31—14th Annual Technical Conference, Society of Plastics Engineers, Sheraton-Cadillac Hotel, Detroit, Mich.

Jan. 29-31—Fourth Annual Meeting, American Astronautical Society, Main Auditorium, Engineering Societies Bldg., 29 W. 39 St., New York City.

Jan. 30-31—Seventh Annual Instrument Short Course, sponsored by Southern California Meter Association and Los Angeles Harbor Junior College, at Los Angeles Harbor College, Wilmington, Calif.

Jan. 30-31—American Society for Engineering Education, 1958, College-Industry Conference, U. of Michigan, Ann Arbor.

Feb. 2-7—American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York City.

Feb. 3-4—Industry-Service Symposium Flight Control-Panel Integration, Biltmore Hotel, Dayton, Ohio. For details: Mr. J. H. Kearns, Box 942, Dayton.

Feb. 4-6—13th Annual Conference and Exhibit, Reinforced Plastics Div., Society of the Plastics Industry, Inc., Edgewater Beach Hotel, Chicago, Ill.

Feb. 10-14—American Society for Testing Materials Committee Week, Hotel Statler, St. Louis, Mo.

Feb. 17—1958 Conference of Professional Divisions, American Society of Mechanical Engineers. Theme: International Geophysical Year—Technology at the Threshold. Hotel Huntington-Sheraton, Pasadena, Calif.

(Continued on page 6)

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RANGE: Adjustable 0 to 15 psia (0 to 760mm Hg)

REPEATABILITY: ±1mm Hg.

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Operates under severe environment from atmospheric pressure to vacuum with accuracy of 2mm Hg.

The Electroset Pressure Switch offers a new and easier way to calibrate and set a pressure switch from a remote position. The contacts are automatically adjusted simply by applying the desired switching pressure and momentarily energizing a solenoid. When the solenoid is de-energized, one contact is securely clamped while the other contact remains free to move with changes in pressure. Once set, the switch will open at pressures below the calibrating pressure and close at pressures equal to or above the calibrating pressure.

The Electroset Pressure Switch is vacuum sealed, isolated from dirt, moisture or corrosive fluids, including the fluids used to actuate it. It is ideally suited for industrial process control applications where an adjustable switch must be located in a remote or inaccessible location or where the switch must operate in an atmosphere which would degrade the performance of a non-hermetically sealed unit. Among military applications are arming of warheads and control of aircraft or missiles. Write for Technical Bulletin 1570 to Trans-Sonics, Inc., Dept. 7, Burlington, Massachusetts.

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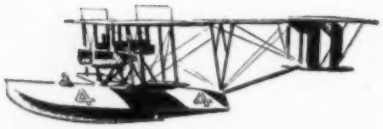

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AVIATION CALENDAR

(Continued from page 5)

Feb. 19—"Are Flying Saucers Fact or Fancy?," Dr. Hugh Winn, Missile and Ordnance Systems Department, GE, Engineers Club, Philadelphia, Pa.

Mar. 3-6—Third Annual American Society of Mechanical Engineers Gas Turbine Conference and Exposition, Shoreham Hotel, Washington, D. C.

Mar. 5-6—Second Annual Shock Tube Symposium, Palo Alto, Calif. For details write: Commander, Air Force Special Weapons Center, Kirtland AFB, N. M., Attn: R. R. Birukoff, SWRS.

Mar. 13-14—Institute of the Aeronautical Sciences, National Flight Propulsion Meeting (Secret clearance required), Hotel Carter, Cleveland, Ohio.

Mar. 13-14—Fifth Annual Heat Transfer Technical Conference, Oklahoma State University, Stillwater, Okla.

Mar. 13-14—Second National Conference on Aviation Education, Hotel Mayflower, Washington, D. C.

Mar. 17-20—Joint Aviation Conference, American Rocket Society-American Society of Mechanical Engineers, Statler-Hilton Hotel, Dallas, Tex.

Mar. 17-21—1958 Nuclear Congress, managed by American Institute of Chemical Engineers, 25 W. 45 St., New York City.

Mar. 18-19—Conference on extremely high temperatures (over 30,000K), sponsored by USAF Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass.

Mar. 18-19—First Inter-Service and Industry Symposium on Guided Missiles Training Equipment (limited to those with Secret clearance) Naval Ordnance Laboratory, White Oaks, Silver Springs, Md. For details write: Mr. J. G. Vaeth, Head of New Weapons & Systems Division, U. S. Naval Training Device Center, N. Y.

Mar. 24-27—Institute of Radio Engineers, National Convention, Waldorf-Astoria Hotel and New York Coliseum, N. Y. C.

Mar. 24-29—Fourth International Instrument Show, Caxton Hall, London.

Mar. 30-Apr. 1—RFC-RNAS Reunion (World War I), Toronto, Canada. Contact: C. B. Stenning, Chairman, 149 South Drive, Toronto 5.

Apr. 8-10—Eighth International Symposia, Electronic Waveguides, Microwave Research Institute of Polytechnic Institute of Brooklyn Engineering Societies Bldg., 29 W. 39 St., New York City.

Apr. 16-19—14th Annual National Forum, American Helicopter Society, Sheraton-Park Hotel, Washington, D. C.

Apr. 17-18—Institute of Environmental Engineers, Second Annual Technical Meeting, New Yorker Hotel, New York City.

Apr. 22-24—1958 Electronic Components Conference, Ambassador Hotel, Los Angeles, Calif.

Apr. 28-30—Second Annual Astronautics Conference, sponsored by Air Force Office of Scientific Research and Institute of Aeronautical Sciences, Shirley Savoy Hotel, Denver, Colo.

May 4-7—Fourth National Flight Test Instrumentation Symposium, Park Sheraton Hotel, New York City.

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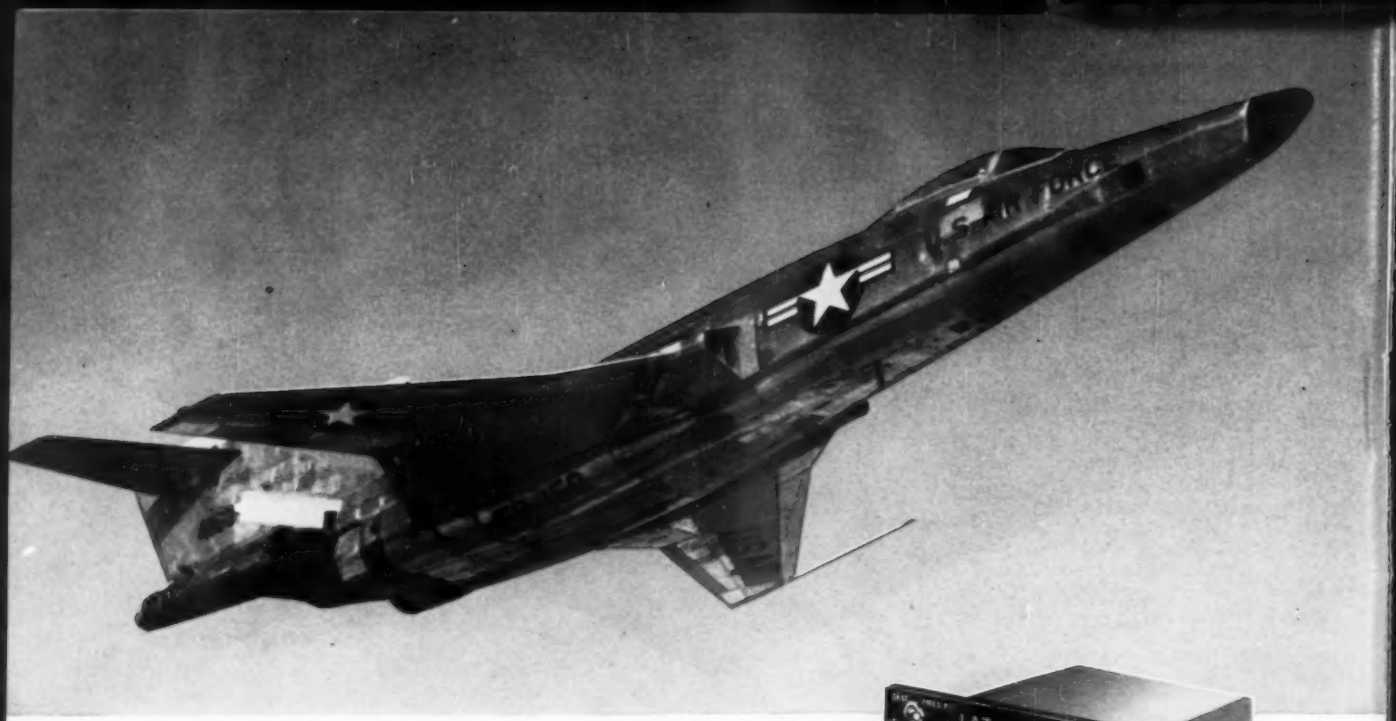

▲ Among new, fast military aircraft being equipped with the ASN-7 Automatic Navigation Computer, are the McDonnell Voodoo RF-101 photo-reconnaissance plane, shown above, and the F-101B all-weather interceptor. Prior to setting a new world's closed-course speed record of over 1200 mph, the Voodoo had set new transcontinental speed records. Speed and range of the Voodoo give full scope to the ASN-7's usefulness. Flight-indicator dial and control panel (right) give pilots an indication of where they are, their ground track, and the course and distance to their destination and to alternate destinations.

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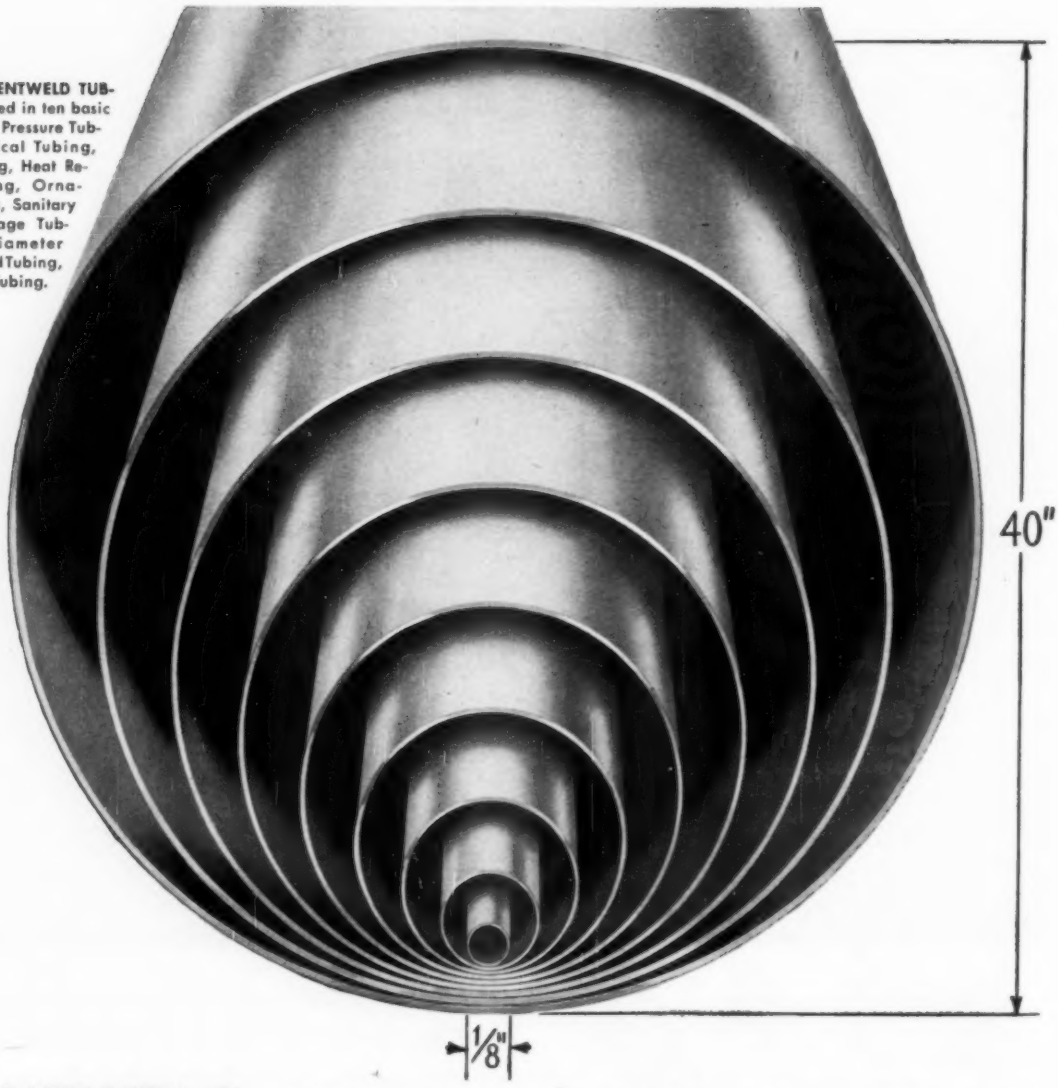

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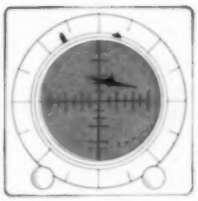

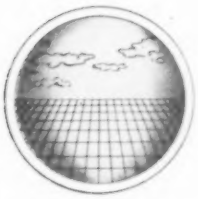

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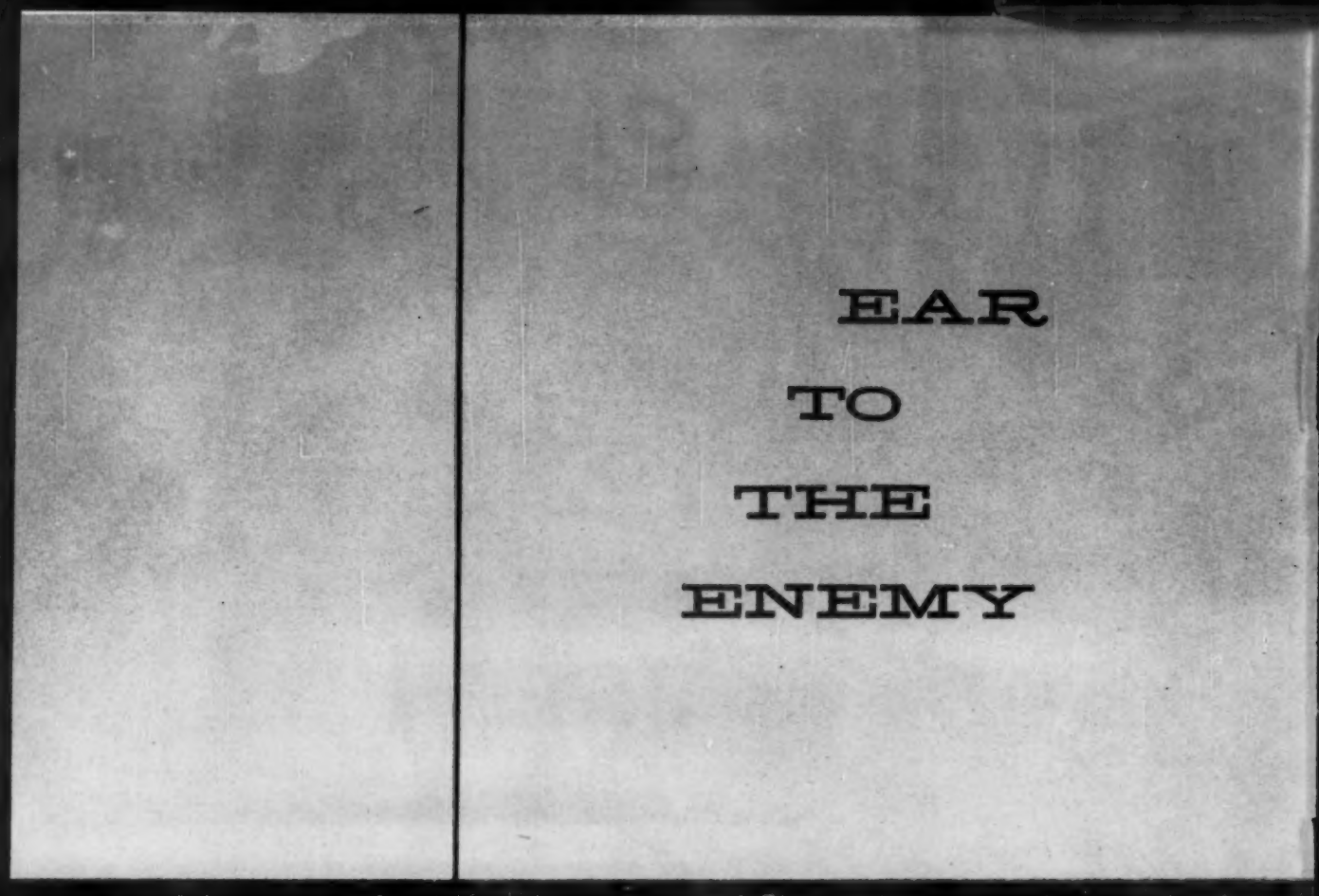

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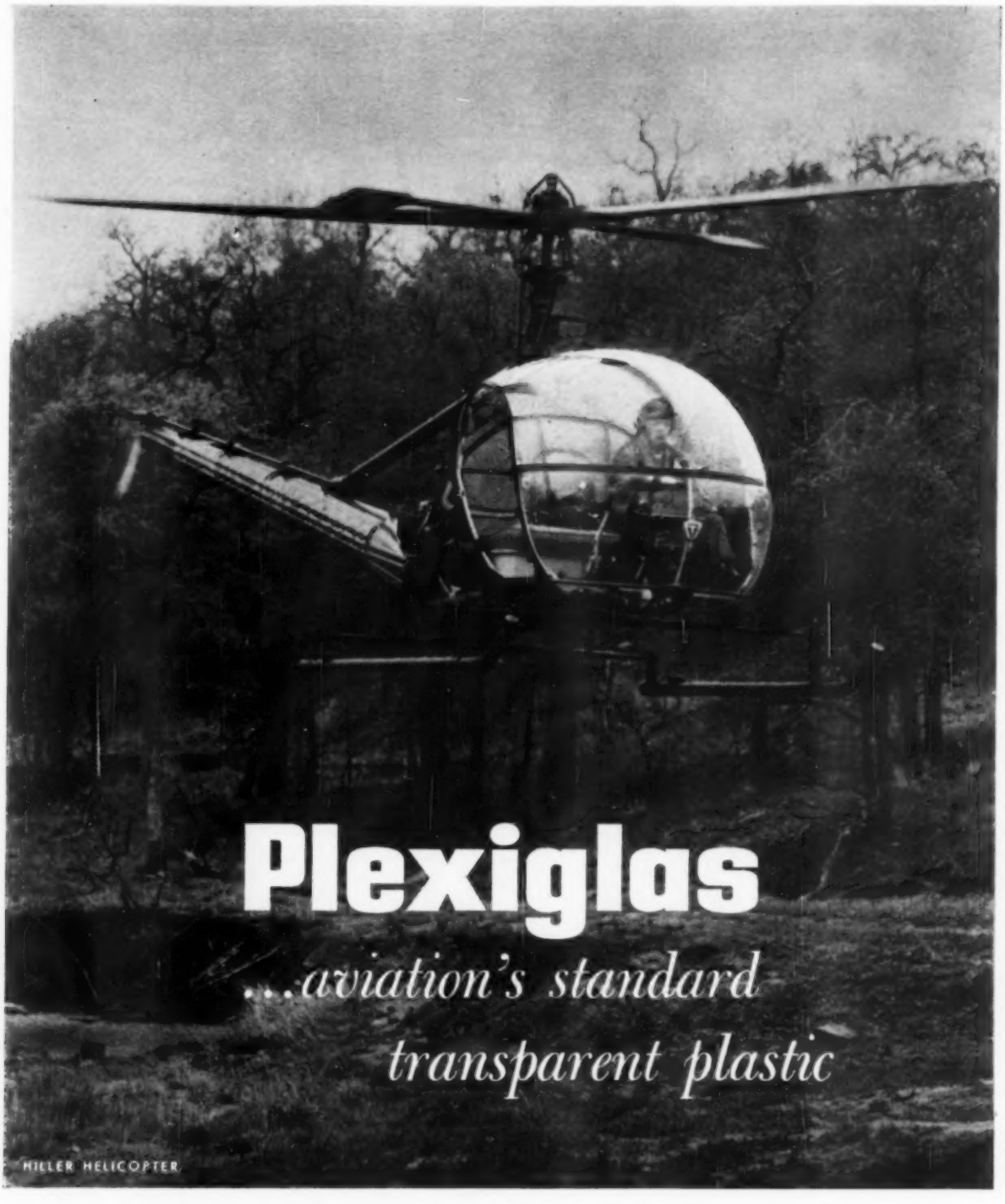

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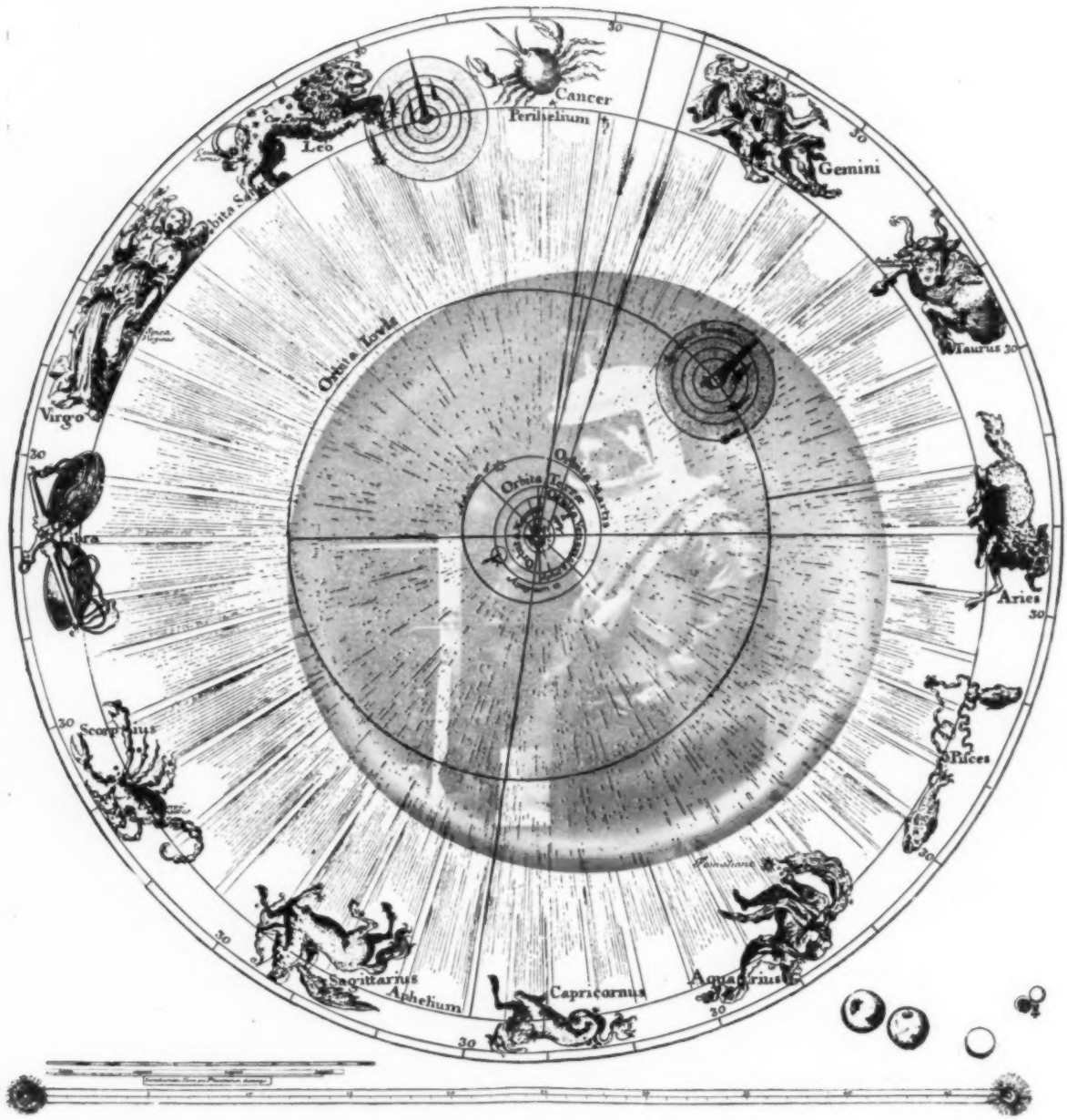

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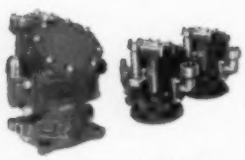

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COVER: Nucleus of Tactical Air Command's striking force flies in formation. A Boeing KB-50 aerial tanker leads while refueling a McDonnell RF-101 reconnaissance aircraft (left wing), a Douglas B-66 tactical bomber (aft) and a North American F-100 fighter (right wing). Behind are two Lockheed C-130 turboprop transports which provide personnel and supply airlift to combat tactical strike forces in forward areas.

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AVIATION WEEK • January 27, 1958 • Vol. 68, No. 4
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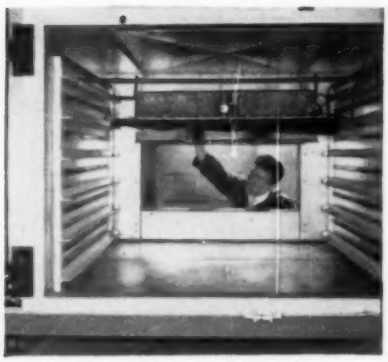
New B. F. Goodrich laboratory is proving ground for fuel cells

B. F. Goodrich Aviation Products' new Fuel Cell Development and Testing Laboratory at the big BFG Los Angeles plant is the last word in fuel cell research. Here, engineers maintain constant quality checks on cells being produced for many aircraft including the Lockheed 1049, T-33 and F-104, the Boeing B-52, the Douglas F4D and the Northrop T-38. In addition, fuel cell designs and materials are being developed to meet the requirements of future airplanes still on the drawing boards.

A representative sample of the laboratory's facilities is shown here. Among the specialized types of apparatus are a giant "hot and cold" room, testers for ozone, abrasion and vibration, and many, many more.



FABRIC TEST. B. F. Goodrich technician examines new fuel cell fabric that has undergone a heat aging and pressure test in 700° F. oven.

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EDITORIAL

The Critical Role of ARPA

The Advanced Research Projects Agency recently created by Defense Secretary Neil McElroy as a result of a specific directive from the White House has the potential to accomplish tremendous results or to critically cripple the vast new weapons development programs that are so essential to the future survival of this nation. ARPA, perhaps more than any other portion of the Defense Department except the comptroller's office, could be the key to whether our military posture will rise again to a position of clear and unchallenged superiority. ARPA should have little concern with the past except to avoid the tragic errors that timid men and unimaginative outlooks have concocted in post-war development history. Its concern is with the future, beginning primarily with the exploration of space and development of militarily useful space vehicles and equipment.

The major problem in maintaining a U.S. position of significant superiority in the technological race with the Soviet Union is not our technical brains, industrial resources or even the mirage of an engineering shortage. It is the type of men who are appointed to key positions along the decision-making chain governing military research and development and the length, vagueness and indecision that has developed by accretion during the past decade. It lies primarily in the layer upon layer of bureaucracy that covers the basic research and advanced development effort of the working level military-science-industry complex like an asbestos blanket, suffocating bold new concepts and urgent action with equal facility.

ARPA has an excellent chance of becoming just another and even more suffocating layer of bureaucracy atop this already stifling research and development atmosphere. Appointment of William Holaday as acting director of ARPA indicates a trend in this direction. Mr. Holaday's prior performance in the Pentagon shows an overfondness for the ad hoc approach, using further study as a method of avoiding decision. He also shows a strong trend toward political compromise as a solution of technical problems that cannot be compromised without ultimate disaster.

Mr. Holaday's decision to put both the USAF Thor and Army Jupiter intermediate range missiles into production indicates he has difficulty distinguishing between a weapon and a weapon system. His more recent decision to separate the detection phase of the anti-missile system from the development of the guidance and defensive missile portions again emphasizes his almost total lack of understanding of the weapon system concept. Regardless of which military service is to operate the missile defense system the act of splitting development of its basic components into two separate military and industrial management problems is a guarantee of critical future problems at the very time the system is scheduled to be operationally effective.

Another holdover from the technically timid regime of former Defense Secretary Charles E. Wilson is Donald Quarles, who now functions as Deputy Secretary of Defense after prior service as Secretary of the Air Force and Assistant Defense Secretary for Research and Development. Although Mr. Quarles' career in Western Electric and the Bell Laboratories was largely administrative, he has cloaked himself in the Defense Department with the aura of a technical expert. He has not hesitated to veto the consensus of genuine technical experts on the strength of his personal opinion or arbitrary budget directives.

An examination of Mr. Quarles' public statements reveals that he has been more consistently wrong in underestimating the pace of Soviet technical development than anybody in the Defense Department except Mr. Wilson. Even today, he is unwilling to admit that it poses any unusual problems for the future defense of this country. Mr. Quarles has also sung loudest in the official chorus that attempted to deny the existence of new Soviet weapons even when the facts on their performance were well known in the Pentagon.

It is also interesting to evaluate some of Mr. Quarles major technical decisions that are not so clear publicly in light of his future qualifications to influence the pace and scope of ARPA work. A few years ago when the Air Force research and development budget was being viciously squeezed under a constant level budget policy that prevented acceleration of key basic research and critical development areas in which our position is now being challenged by the Soviets, Mr. Quarles, as Secretary of the Air Force personally overruled the unanimous position of the Air Council and USAF's research and development experts in presenting a more adequate program to Congress. Two years ago, a USAF general officers board composed of its top research and development commanders proposed a program of military useful space research, including consolidating all space research activities around the nucleus already existing at Holloman Air Development Center. This plan too was unanimously approved by the Air Council but personally vetoed by Mr. Quarles on the ground that it involved spending money to no good purpose. Six months later, USAF tried again with a program to develop an exploratory space vehicle. This too got Mr. Quarles' personal veto.

The past performance of Messrs. Holaday and Quarles on matters of critical technical decision raise grave doubts as to the wisdom of continuing to entrust them with this critical activity, particularly as it relates to ARPA. It will be difficult for even the best man that could be found to head ARPA to work effectively in an atmosphere dominated by the Quarles-Holaday philosophy. It also will be extremely difficult for ARPA to work out the complex and effective relationships with the already operating research and development programs of the country with the same type of mentality that characterizes the vast majority of the 2,300 employes in the office of the Secretary of Defense. They and their system have proved utterly incapable of moving with sufficient speed, imagination and daring to play for the tremendous stakes involved in ARPA's proposed activities. These are some of the pitfalls Defense Secretary McElroy must avoid if he is to make ARPA a vital success. Next week we will discuss some of the possible avenues of attack that could make ARPA effective and successful.

—Robert Hotz

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Photo shows MIG Gyro with companion unit, GG56 Pendulous Accelerometer (left). GG56 has threshold of 5×10^{-5}g and linearity of better than 0.1% up to ± 10 g.

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In the Front Office

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K. R. Herman and **C. G. Holschuh**, executive vice presidents, Sperry Rand Corp., New York, N. Y. **J. F. Forster** succeeds Mr. Herman as president of Vickers, Inc., a Sperry Rand subsidiary; **Dr. C. A. Frische** succeeds Mr. Holschuh as president of Sperry Gyroscope Co., division of Sperry Rand.

Dr. Carl L. Kober, vice president and technical director, Crosley Division, Avco Manufacturing Corp., Cincinnati, Ohio.

Dr. Felix A. Kalinski, vice president to coordinate and direct contracts, customer relations and engineering divisions, Vertol Aircraft Corp., Morton, Pa.

H. Grady Thrasher, vice president, Southern Airways Co., Atlanta, Ga.

Lt. Gen. Laurence C. Craigie (USAF, ret.), a vice president, American Machine & Foundry Co., New York, N. Y., in charge of the company's ballistics missiles launcher program.

William C. Ridge, vice president-production, John A. Roebling's Sons Corp., Trenton, N. J.

A. W. Beck, vice president-marketing, Robertshaw-Fulton Controls Co., Richmond, Va.

Fred W. Elliott, a vice president, H. K. Porter Company, Inc., New York, N. Y.

Honors and Elections

Dr. Louis N. Ridenour, chief scientist of the Lockheed Missile Systems Division, has been named to the National Advisory Committee for Aeronautics' newly created Committee on Space Technology.

Changes

Joseph E. Mulheim, director-aircraft products engineering and manufacturing, and **Hayes Crapo**, chief engineer-aircraft products, The Leland Electric Co., division of American Machine & Foundry Co., Dayton, Ohio.

Irwin I. Steinberg, general manager, Vibro-Ceramics Division, Gulton Industries, Inc., Metuchen, N. J.

J. F. Harper, assistant managing director, Bristol Aircraft Limited, Bristol, England.

Ralph R. Theile, Director-Cargo Traffic, and **C. B. Newman**, Assistant Director-Military Bureau, Air Traffic Conference, Air Transport Association of America, Washington, D. C.

Edward R. Neumann, manager, Missile Products Division, Fruehauf Trailer Co., Detroit, Mich.

Edwin A. Speakman, manager of planning, Defense Electronic Products, Radio Corporation of America, Camden, N. J.

Charles A. Wolf, director of marketing, Autonetics Division, North American Aviation, Inc., Downey, Calif.

John Thoerle, Eastern regional manager, Avien, Inc., Woodside, N. Y.

INDUSTRY OBSERVER

► New approach to missile development will be tried soon by Navy's Bureau of Aeronautics in an effort to cut the development cycle for air-to-air and air-to-surface missiles. Under the new policy, BuAer initially will award a contract only for development of the guidance system—longest lead-time item—to meet specific tactical requirements. Only after the guidance system is developed sufficiently to establish feasibility will the bureau select a prime contractor to develop the missile and its powerplant.

► **Westinghouse and General Electric are top candidates for the design and construction of a complex high temperature electrical system for North American Aviation's WS-110A chemical bomber. Electrical installation will have to meet operational environments not previously encountered in any manned aircraft.**

► Navy Air Missile Test Center, Pt. Mugu, Calif., will modify the launching pad now being used for Regulus II tests so that it can accommodate test vehicles of the Polaris fleet ballistic missile scheduled to be fired over Mugu's sea range.

► **General Electric J79 turbojet engine has a 9½ in. long variable inlet guide vane, indicating an unusually high air capacity considering the powerplant's 33 in. compressor diameter. J79-4, designed for Navy, has a stator and front frame of steel instead of magnesium as in the J79-3 engine used in Lockheed's F-104. J79-5 is projected as a powerplant growth for the Convair B-58. The J79-7 is an F-104 growth project and will have a 2 in. larger turbine diameter than earlier models. All will have more thrust and better fuel consumption than the first J79 production engines.**

► Airways Modernization Board will seek industry proposals within the near future for both an air-ground data link system for operational evaluation and a point-to-point data link system for transfer of data between traffic control computers at adjacent Air Route Traffic Control Centers.

► **Watch for Fiat's Aviation Division to make a strong entry into the small and medium turbojet engine field later this year. Company already has developed small turbojets as a means of gaining experience and as the powerplant for one of the firm's new helicopters. It will soon branch out into the higher thrust brackets.**

► Vertical takeoff jet fighter being developed by Bell Aircraft for Navy reportedly looks so promising that Air Force is providing some support funding. If project continues to pan out USAF could buy the Bell VTOL and eliminate or cutback its projected design competition for a dispersed-site fighter-bomber for Strategic Air Command bases.

► **Equipment for tactical intermediate range ballistic squadron now calls for a complement of 20 missiles with a 10% spares level. Spares here means one fully assembled, ready-to-go missile with warhead on reserve for every 10 in the normal complement. If missile in normal complement malfunctions in test, reserve missile will be immediately moved in to replace it. Malfunctioning missile will be repaired when time allows.**

► Bell Helicopter Division in Fort Worth is cooperating with Costruzioni Aeronautiche Giovanni Agusta on the technical design of one of two helicopters the Italian firm is developing on order from the Italian Air Force. Bell-Agusta project is piston-engined, probably in the six-to-eight seat category. Second project, completely designed by Agusta engineers, is much larger, powered by gas turbines.

► **Piaggio 166, landplane version of the twin-engined executive amphibian sold in the U. S. as the Royal Gull, is nearing the end of the company flight test program. Certification tests made for both Italian registry and the Civil Aeronautics Administration will begin before the end of the month. Aircraft has the same powerplant, wing and landing gear as the Gull, but the fuselage is larger, has room for two additional passengers.**

••••••MISSILE GUIDANCE SYSTEMS•••••••

Projects of H. T. Budenbom,
Senior Scientist, Stavid Engineering, Inc.

Included in Mr. Budenbom's 25 patents and numerous technical papers are his original contributions in monopulse development and authorship of many new concepts in the application of electronics to modern warfare. His experience and inventive talents are being applied to Stavid's projects in weapon systems development and missile electronics. Mr. Budenbom is one of a group of outstanding scientists and engineers at Stavid who are working on advanced concepts . . . years ahead of actual systems development.

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Washington Roundup

Censorship Review?

Department of Defense censor's deletion of certain testimony given before the Senate Preparedness Subcommittee could touch off another congressional inquiry into the government's censorship policy. Some subcommitteemen expressed considerable dissatisfaction with deletions which, they said, left the impression that USAF Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, blamed the subcommittee investigation for spreading the "mistaken conclusion" that the U.S. is militarily inferior to Russia.

In the deleted remarks, Gen. Twining specifically said, "I am not talking about these hearings."

The remarks were later restored by the Defense Department with the explanation that they had been deleted because the question asked of Gen. Twining that led to the remarks referred to a prior exchange involving comparative data that contained security information.

In the official transcript of one witness's testimony, several pages were deleted entirely. Complete exchanges were deleted in others and, in some, only figures pertaining to production, delivery times and similar matters were cut out.

President's Refusal

President Eisenhower politely refused last week to make the Killian and Gaither Panel reports on the nation's defenses available to the Senate Preparedness Subcommittee investigating national defense. The President in a letter to Sen. Lyndon Johnson (D.-Tex.) subcommittee chairman, said, "We must be careful to maintain the proper separation of powers between the Executive and Legislative Branches of Government," which he added is vital to preclude the exercise of arbitrary power by any one branch. Johnson expressed disappointment at the White House's refusal and said the reports "would be helpful to the subcommittee." He added, however, that, as a result of the investigation the subcommittee is in a good position to form its own conclusions, on just where the U.S. stands in the military-technological race with the Soviet Union.

Indigestion

The President's aversion to heavy reading also led to a streamlining of Central Intelligence Agency's daily intelligence digests. At a recent National Security Council meeting, CIA Director Allen W. Dulles reportedly complained that readership of the digests is too low among top policy makers. An annoyed Eisenhower replied that the digests are too ponderous, and prescribed brevity, headlines and illustrations—maps with red arrows marking strategic spots. In return, the President promised to make sure the policy makers do their skull practice. No change is reported, however, in the map room situation. Revival of the White House's wartime map room—suggested last year by Nelson A. Rockefeller but vetoed by former Under Secretary of State Herbert Hoover, Jr.—apparently is not planned.

Employment Brake Eased

Defense Secretary Neil H. McElroy, with an assist from Sputniks I and II, is relaxing the brake on civilian employment ordered last July by his predecessor, Charles E. Wilson. The Wilson order blocking civilian defense hiring already has reduced the rolls by 68,503 employes—or almost 6% of the department's civilian strength. McElroy now says the services will be permitted to fill "a limited number of civilian vacancies caused by normal attrition."

Best estimate is that at least 25,000 employes will be brought in.

Submarine Defense

Sen. Henry M. Jackson (D.-Wash.) a strong advocate of atomic Polaris-launching submarines for the U.S., is now charging that the Administration is "ignoring the vital defense area" of early warning and detection of enemy submarine-launched missiles. He said the missile threat from the sea is equally as great as the missile threat from the Eurasian land mass. Jackson wants a minimum U.S. fleet of 100 atomic missile-launching submarines.

Shift in Blame

Reiterating an earlier stand that airlines are being forced to ask for a fare increase because of too much competition, United Air Lines President W. A. Patterson last week chose to shift some of the blame for the overdose of competition during the past two years from the Civil Aeronautics Board to congressional pressure. During testimony at the general passenger fare investigation, he added that "it is no secret that this pressure was inspired by what became a discredited segment of the non-scheduled operators." Patterson included the airlines themselves as the cause of excessive competition by pointing out that larger airlines sought route extensions because of a liberal "philosophy" toward competition while smaller airlines sought new routes for expansion. Cities also add to the pressure on the Board but, Patterson concluded, "the fact is, by acceding to these pressures and creating excessive competition, the Board has materially affected the current and economic position of the airlines, large and small."

'Bailment' Opposition

House Military Operations Subcommittee has found little support thus far for the Air Force's proposed "bailment program" by which commercial airlines operate military-owned airplanes in the transportation of passengers and cargo. Industry and government witnesses have opposed the idea, but Air Force and Military Air Transport Service witnesses are still to be heard.

Under the proposal, a commercial airline would operate five MATS Fairchild C-118s, for the transportation of passengers in the Pacific area. Another line would operate five MATS C-54s to ferry cargo over the Atlantic.

Industry spokesmen say the bailment program was proposed to offset the growing demand that MATS turn over a bigger share of its traffic to commercial carriers. Rep. Chet Holifield (D.-Calif.), subcommittee chairman, says military witnesses will take the stand next, followed by Air Force and MATS to complete the investigation of MATS and Defense airlift operations.

—Washington staff

USAF, Army Divide Anti-Missile Task

Three long-range radar sites planned by Air Force; Nike-Zeus gets nod over Convair-RCA Wizard.

Washington—Three long-range radar detection stations to be built by the Air Force as its part in the nation's planned defense against intercontinental ballistic missiles will be located in Alaska, Greenland and another foreign territory. They will cover all of Russia.

One of two types of radars to be used at each site is an outgrowth of a prototype now being operated by USAF in Turkey to detect test firings of Russian missiles (AW Oct. 14, p. 26).

Primary purpose of these sites for the first few years will be to provide Strategic Air Command bombers with a 15-min. warning time.

Army's Nike-Zeus anti-missile missile system—chosen last week over the competitive USAF Wizard system—is not expected to be operational before about 1964—approximately **four years after** long-range detection sites become operational.

Defense Department's choice of the Army anti-missile was part of an action that also gave control of both the missile and the detection network to the new Advanced Research Projects Agency and made Guided Missiles Director William Holaday acting director of ARPA.

McElroy Outlines Program

Defense Secretary Neil McElroy sent memoranda to the secretaries of Army and Air Force ordering the changes. In a series of three explanations, concerning the memoranda, Defense said:

- **Army is to continue** development of Nike-Zeus "as a matter of urgency, concentrating on system developments to demonstrate the feasibility of achieving an effective defense against the ICBM."
- **USAF is to discontinue research** and development on the Convair Wizard missile but continue "as a matter of urgency to concentrate on that part of its Wizard program that pertains to the radar and data handling aspects including its relationship to SAGE and other radar capabilities."
- **"Both services are directed** to arrange for the closest possible cooperation among contractors so that the ultimate system to be developed is mutually compatible. No significant changes can be made in these programs without the specific approval of the Director of ARPA."

Defense also said the memos apply to development only and that roles and missions have not yet been assigned. Former Defense Secretary Charles E. Wilson ordered on Nov. 26, 1956, that Army be responsible for point defense and USAF for area defense. Under his definition at that time, point defense included surface-to-air missiles "for use against air targets at expected altitudes out to a horizontal range of the order of 100 nautical miles." Nike-Zeus' range is estimated to be between 200 and 300 mi.

Anti-Missile Funding

Although ARPA apparently will have strict control over continued development of USAF's detection system, funds included in the Fiscal 1958 supplemental budget request and the Fiscal 1959 budget apparently will remain in the Air Force account.

On the other hand, Nike-Zeus money apparently will be a part of the ARPA account, even though Army continues to do the work.

Three long-range radar sites will include surveillance radars similar to the AN/FPS-17 sets in Turkey and Laredo, Tex., plus tracking radars similar to the one now operational at Millstone Hill in Massachusetts (AW Nov. 25, p. 34).

These will be tied in with Air Defense Command at Colorado Springs, Colo., and the eventual Nike-Zeus system will, in turn, use three more radars—surveillance, acquisition and tracking—plus command guidance system.

Stever Tour

Washington—Stever Committee conducting a major review of all Air Force research activities (AW Jan. 13, p. 26) has completed a tour of six Air Research and Development Command bases and will begin a tour of the rest in about three weeks.

Committee was created by USAF at the suggestion of Lt. Gen. Samuel E. Anderson before he assumed command of ARDC last August. It is expected to report to him sometime in March.

Committee members were briefed at Air Force headquarters, ARDC headquarters and ARDC's Office of Scientific Research before touring western and mid-western bases, including Ballistic Missile Division, Flight Test Center, Missile Development Center, Special Weapons Center, Arnold Engineering Development Center and Wright Air Development Center.

Eastern tour will include Rome Air Development Center, Cambridge Research Center, Missile Test Center and Armament Center.

Radio Corp. of America is prime contractor for the three far northern sites and will handle high power tubes, etc. General Electric Co. will build much of the rest of the equipment, including antennas, pipe organ antenna feeds, etc., as it did in the FPS-17.

Western Electric, because of its experience in building the White Alice scatter communications system, will handle communications. A number of other subcontractors are involved.

Nike-Zeus, a Douglas Aircraft Co.-Bell Telephone Laboratories development, apparently was chosen because it is farther along than the proposed Convair-RCA Wizard, although Wizard had considerably longer range and was technically more sophisticated.

System will require extreme speed and accuracy, and initially anti-missile missiles probably will protect only SAC bases.

Nike-Zeus Range

Nike-Zeus surveillance radar has a 1,000 mi. range, uses a large Luneberg lens with mechanical feed system. Its job is to maintain continuous surveillance following initial warning from the long-range system, and assign incoming targets to local area acquisition radars.

Acquisition radar has a range of 600 mi. with a similar antenna but with electronic steering. Acquisition radar would have several Nike-Zeus batteries assigned to it. Each battery would in turn have its own tracking radar and missile guidance system.

On assignment from surveillance radar, acquisition radar tracks the target long enough to gain trajectory data, which it furnishes to whatever tracker it assigns. Tracking radars are monopulse systems similar to present Nike tracking sets.

Surveillance and tracking radars use a system of coherent detection, developed by Sidney Darlington of Bell Labs, called Chirp. System cannot discriminate between warheads and decoys.

At present, both Wizard and Nike-Zeus have projected kill probabilities of only about 25% against ICBMs (AW Jan. 20, p. 23).

Millstone Radar

Millstone Hill type of radar, developed by Lincoln Laboratory and named for its operational site 30 mi. north of Boston, tracked both Soviet Sputniks after radio direction finding techniques were employed to establish correct aiming point.

Millstone employs an 84 ft. diameter parabolic reflector which can be rotated 360 deg. in azimuth and can be elevated from horizontal to zenith.

Reflector is mounted on a 90 ft. tower, and extremely high power transmissions are made possible by specially designed klystron tubes measuring 11-ft. high.

Testimony by Lt. Gen. Donald L. Putt, USAF Deputy Chief of Staff for Development, before the House Defense Appropriations Subcommittee indicates there will be two other experimental installations of the Millstone Hill type—one at Saskatchewan, Canada, to study effects of the aurora on radar reception and the other at an undisclosed site.

Gen. Putt also testified about a transistorized computer the size of a conference table to be located at the radar sites to predict launch and impact. He said it is 75% complete. This is believed to be the special transistorized digital computer designed and built by Lincoln Laboratory for use with Millstone (AW Nov. 25, p. 34).

Radar Breakthrough

Gen. Putt said "this hardware program" plus operational ballistic missile detection radars "at Laredo, Tex.," and "overseas" are "only the first step" in the development of the complete ground environment for a ballistic missile defense system, but it is an important first step, because components developed and test results gained are already proving quite valuable in this program.

"The real breakthrough that allowed Air Force to start actively planning the installation of a ballistic missile early warning system," Putt testified, "was the development of the high-powered transmitters necessary to obtain the long detection ranges (3,000 nautical mi.) against the ballistic missile.

". . . In September (1957), we had a breakthrough that made it technically possible for us to do this job, design and construct the equipment."

Subsequently, Putt said, a Defense Department technical committee reviewed the situation and decided USAF could have a greater capability than originally planned and in the same time period if it capitalized on the breakthrough, "and the total cost of this more sophisticated system would be $721 million. . ."

Supplemental Bill Passes First Hurdle

By Katherine Johnsen

Washington—House Appropriations Committee last week approved a $1.2 billion "minimal advance installment" on the Fiscal 1959 defense budget requested by the Administration under its post-Sputnik acceleration program. The committee warned that, "in the critical areas of space satellites and ballistic missiles, we are generally behind the USSR."

The funds, which under the pre-Sputnik plan would have been included in the Fiscal 1959 budget (AW Jan. 20, p. 25), will now be available for use during the remaining months of Fiscal 1958.

More '59 Funds?

There were also these two developments:

• **House Appropriations Committee** members reported that Department of Defense has indicated that a new request for additional funds—over and above the $39.1 billion included in the Fiscal 1959 budget submitted to Congress (AW Jan. 20, p. 28)—will be requested shortly. The Subcommittee on the Armed Services headed by Rep. George Mahon (D.-Tex.) begins hearings this week on the Fiscal 1959 budget.

• **Group of key Democrats** led by Sen. Henry Jackson (D.-Wash.) worked on an expanded defense program which would add approximately $2 billion to the $39.1 billion program of the Administration.

The $1,260 million supplemental, now up for Senate consideration, would provide for:

• **Acceleration of the Atlas** intercontinental ballistic missile operational capability, $20 million.

• **Acceleration of the operational** capability of the Thor and Jupiter intermediate range ballistic missiles, $171 million.

• **Acceleration of the ballistic** missile defense capability, $169 million.

• **Research and development** on Army's Jupiter, $30 million.

• **Strategic Air Command** alert facilities at 14 locations in the U.S., $24.6 million.

• **SAC dispersal,** $194 million. This includes funds for relocation of nine KC-97 tanker squadrons from southern to northern bases in the U.S.

• **Ballistic missile facilities,** $112.4 million. This includes funds for testing and other facilities at Cooke AFB, Calif., and Warren AFB, Wyo., and funds to begin construction of a third base at an undetermined site. Funds for a fourth base are included in the Fiscal 1959 budget.

• **Ballistic missile defense,** $160 million. This provides for installation of warning systems at three operational sites.

• **Semi-automatic ground environment** (SAGE), $29 million.

• **Polaris fleet ballistic missile program,** $350 million. This provides $296 million for construction of three nuclear-powered submarines to carry the Polaris; $31.8 million for missiles, testing and other facilities, and $22.2 million for research and development.

Fund Transfers

The legislation also authorizes these transfers of funds:

• **For financing** of high-priority programs, primarily the Titan ICBM program and the anti-missile missile program, $166 million.

• **For immediate development** of the Redstone follow-on solid propellant missile, the Pershing, $20 million.

• **For acceleration** of the Lacrosse, Little John and Sergeant corps-type missile programs total of $20 million.

• **For Advanced Research Projects** Agency, $118 million in unexpended funds of Army and USAF for outer space and anti-missile missile projects.

Commenting that the $1.2 billion in requests "are conservative in relation to the need in the critical areas," the House Appropriations Committee explained:

"Weeks would be required to explore fully all of the funds that could be incorporated. Since the objective is to buy time, the committee decided that it was the better part of wisdom to act rapidly and thereafter give consideration to other urgent programs which should be expedited."

LeMay Criticism

The allocation also fell short of satisfying military leaders.

USAF's vice chief of staff, Gen. C. E. LeMay, complained that these urgent programs were not provided for:

• **B-52 production funds** to increase the heavy bomber strength from 11 to 14 wings. He pointed out that there are no production funds for the Boeing B-52 in the regular Fiscal 1959 budget and that this means that production will phase out by 1960. Gen. LeMay stood pat on his testimony of a year and a half ago that Russia's long-range air force would surpass that of the U.S. by mid-1959. He explained:

"A new look at the intelligence indicates that they probably slowed up in the heavy bombers a little bit. . . . (However) this new record breaking heavy jet bomber they announced recently may explain some of the Bison slowdown. Therefore, I still think that by mid-1959 there is a good chance that their combat capability will exceed ours."

LeMay noted that "there is nothing

in the supplemental that will further our knowledge of space technology." If funds were provided USAF now, he said, "we could come pretty close to a date of 1958" for reaching the Moon.

LeMay also called for increased production of bombers for Tactical Air Command and interceptors for Air Defense Command.

• **Additional $29 million** immediately, and an additional $100 million in the Fiscal 1959 budget is needed to push the program for the Titan booster, which, LeMay noted, "can be used in the advanced research project (for space travel) as well as serve the basic weapons system."

• **Additional $5.2 million** is required immediately to adapt boosters to the North American-USAF X-15 high-altitude research vehicle in connection with the space program, LeMay declared. He said that $15 million in research funds and $22 million in production funds should be added to the Fiscal 1959 budget for the project.

• **To expedite the chemical bomber** program, LeMay said, an additional $10 million should be made available immediately and $32 million added to the fiscal 1959 budget.

• **USAF is short about $200 million** in funds for electronics and communication equipment and other non-aircraft procurement, he said.

Navy Secretary Thomas S. Gates made clear Navy's dissatisfaction with the elimination of funds for construction of a second nuclear powered carrier in the Fiscal 1959 program. "We have nonetheless every intention in the 1960 budget of requesting another nuclear-powered aircraft carrier," Gates added. "We have provided money in the 1959 budget for the long lead-time items."

Navy submitted two apparently contradictory formal reports on the effectiveness of the missile-submarine combination—one highlights its easy detectability; the other emphasizes its range of dispersal, making anti-submarine operations formidable.

On "the vulnerability of submarines to atomic weapons," Navy reported:

"We can attack the submarine at sea with a high one-shot probability of killing him and can as well attack him in home bases with an equally high probability of destroying the support facilities necessary to his operations at sea. . . .

"The kill radius increases with depth. . . . And increases with the weapon yield. . . . The important thing to note is that a high-speed, deep running submarine is vulnerable, and very much so, to attack with atomic depth bombs, and the deeper she goes to escape detection, the greater her vulnerability. . . . To minimize her vulnerability to the effects of atomic weapons, the submarine must come to shallow depths, which facilitates her detection. Also, the deep submerged submarine probably will not know she has been detected and attacked until it is too late."

Chief of Naval Operations Adm. Arleigh Burke stressed "the limitation" of the Polaris submarine as a weapon. "It is only good for mass destruction," Burke noted. "It is only useful if it carries tremendous warheads. You have to know where the target is. Although it is tremendously useful for a general war . . . or as a deterrent for the starting of such a war, it will not do any good in any other situation. . . . Even in a general war it will have limitations." Burke complained that Navy has a requirement for 18 attack carriers but now has only 15. "Polaris will do some of the things in a general war that a carrier can do, but not many of them," he added.

The second Navy report, on the other hand, declares:

"The modern submarine, with greatly increased underwater speed and endurance, has magnified the anti-submarine problem many times. The most effective and economical method of defeating the submarines is to destroy their home bases, tenders and building yards. . . .

"Those deployed prior to the outbreak of hostilities, plus dispersed units not destroyed by strikes at source, will constitute a sizable threat to our control of the seas.

This is a most difficult task and with present capabilities can be accomplished only by attrition. . . .

"The problem of initial detection is the most difficult one in anti-submarine warfare. It is the one in which we have the least confidence. The submarine is submerged and the oceans are vast. . . . We believe that the carrier is the most effective (anti-submarine) weapon system."

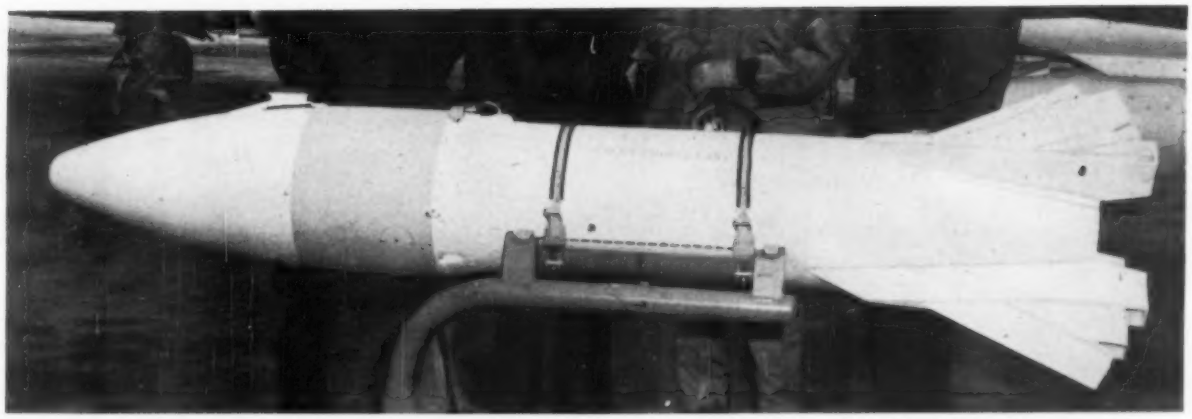
Defense Secretary Neil McElroy, however, was enthusiastic concerning the Polaris project. "Within the last month we have had a very hard look at what might be done to go still faster in Polaris," he told the House Appropriations Committee. "This has been done in consultation with industrial suppliers and in consultation with the technical people." He said that he might be in a position shortly to recommend construction of an additional three nuclear-powered subs to be armed with Polaris, instead of the three now proposed. McElroy said that the "interim" Thor and Jupiter IRBM missile "will be succeeded fairly promptly by a second generation which will be a solid propellant of the general type of a land-based Polaris."

Soviets Test Jet VTOL

Soviet VTOL, called the Flying Stand or Turbolet (flying turbine) by the Russians, is shown during a recent flight over the USSR Flight Research Institute airfield. The aircraft's control system is a combination of deflector vanes in the jet engine exhaust and bleed jets at the tips of the outriggers which the pilot operates through the conventional pedals and stick (AW Oct. 14, p. 26). The bell-shaped engine inlet is located just behind the pilot. The apparent size and weight of the aircraft and its enclosed pilot's position would indicate that the Turbolet's powerplant has a comfortably high thrust to weight ratio. Principal credit for the design is given to Prof. Matveyev and engineers identified only as Rafaelyants, Kavashnin and Lapshin. Test Pilot First Class Yuri Garnaev made the first flight.

Correction

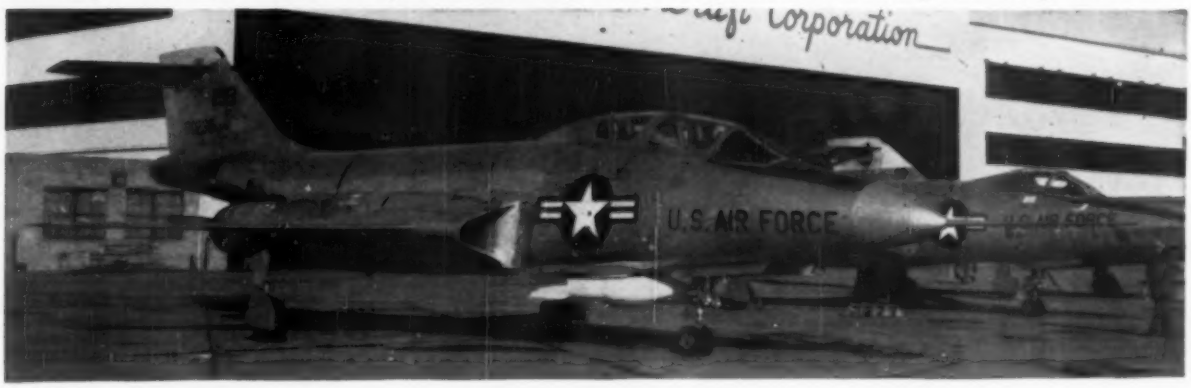
Due to a typographical error, AVIATION WEEK on page 23 of its Jan. 13 issue incorrectly listed the total amount of an Air Force contract with Convair Division of General Dynamics Corp. for investigating the use of newer titanium alloys at $61,388,044. The figure should have been $1,388,044.



Douglas MB-1 Genie air-to-air missile carrying an atomic warhead is shown in flight configuration with stabilizing fins extended.

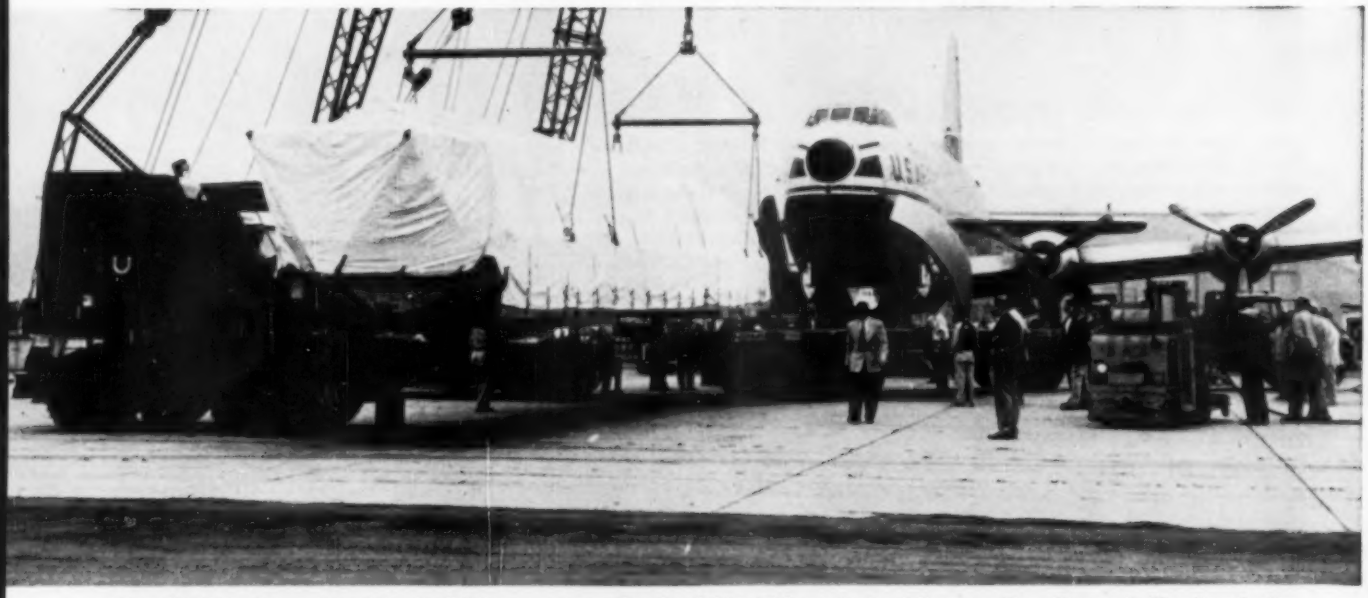
F-101B Carries Retractable-Finned, Air-to-Air MB-1 Genie

Genie is shown (above and below) mounted on a McDonnell F-101B. Genie's fins retract so that it may be carried close to the fuselage. Missile nose is lowered before firing so that it will be launched in a downward arc and its rocket exhaust will not be sucked into the aircraft's engines, causing a flameout. Due to its large size the unguided Genie is carried externally on the Voodoo. The aircraft carries other air-to-air missiles such as the Falcon on a rotating door which is sealed off for Genie installation. Plates (above) have been placed on the fuselage between the Genie and the engine air inlet to keep air flow off the missile from interfering with inlet operation

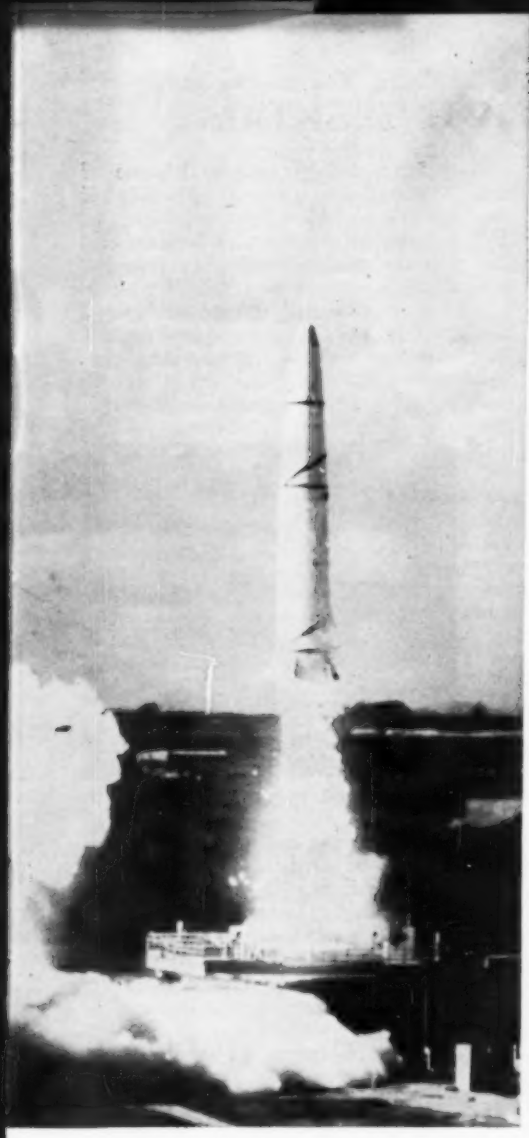


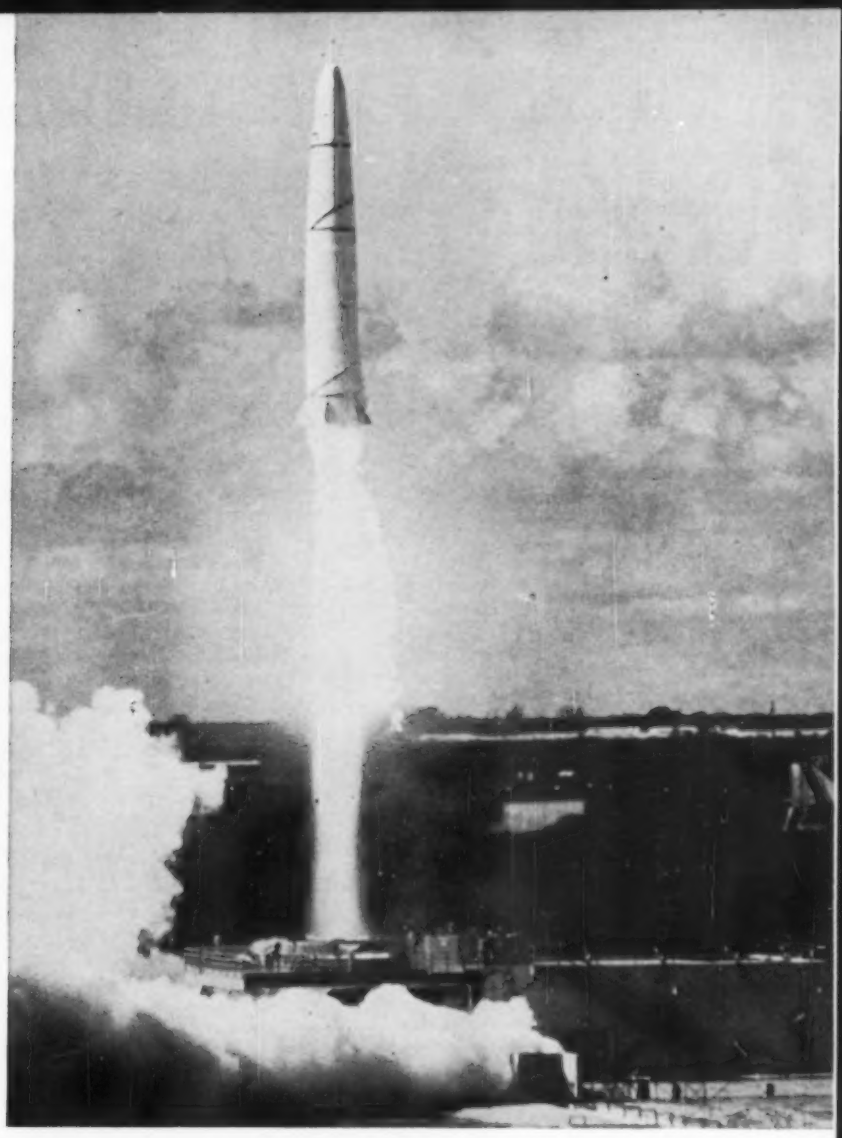
Douglas display of USAF Thor IRBM launching site includes guidance support vans, lower left; liquid oxygen tank, upper left, and smaller fuel tank at upper right. Nose cone on Thor is a dummy, but the blunt, operational nose cone can be seen near portable ladder at right. Thor is raised to launch position and lowered by long arm and hook extending from platform at the base of the missile. Thor engine is a 165,000 lb. thrust Rocketdyne unit. First published pictures of the display at Douglas' Culver City, Calif., plant were carried by Aviation Week in its Dec. 16 issue (p. 32, 33).

Thor Displayed With Equipment, Warhead

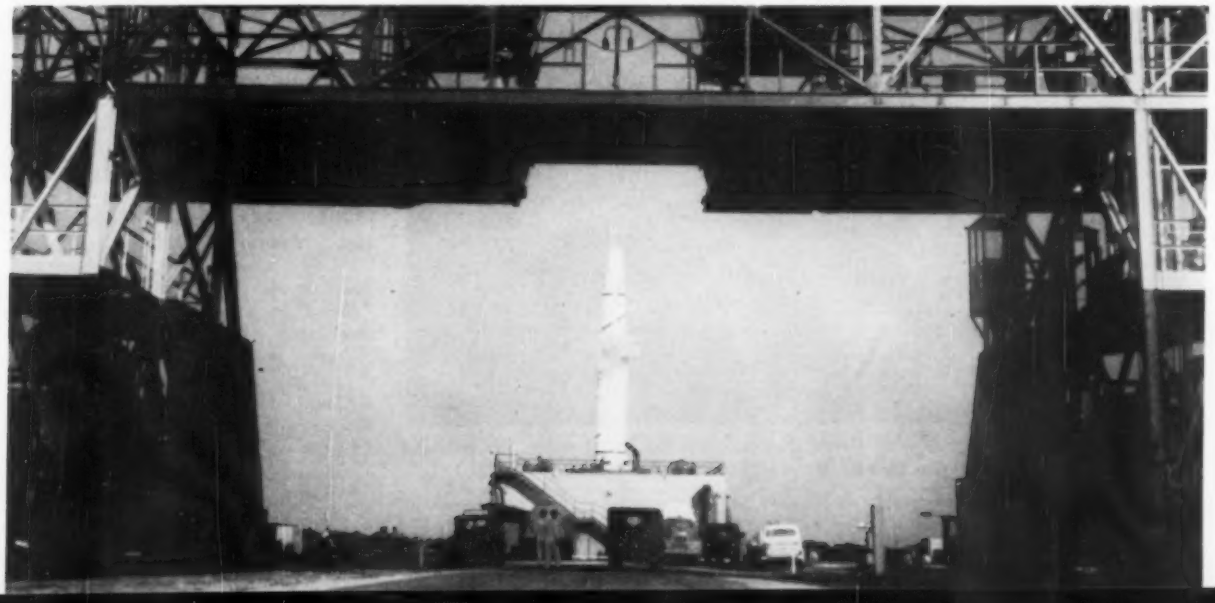


Thor IRBM is shown above being loaded by crane into a Douglas C-124 Globemaster for delivery to Cape Canaveral, Fla., launch site.





Details of the USAF Douglas Thor intermediate range ballistic missile launching site at Cape Canaveral, Fla., are shown in the photos above, taken at a recent firing. Gantry crane has been pulled away from the stand which has adjoining building for test equipment. Other launching pads are visible through the scrub terrain in the background. Below, a Thor on the same launching pad as above is viewed from a different angle, through the rolled back gantry crane.



Missile, Aircraft Acceleration Asked

By Ford Eastman

Washington—Weapons now needed for U. S. defenses and those required in the future can be developed and produced faster and in greater numbers, military and industry witnesses told the Senate Preparedness Subcommittee last week.

The subcommittee was told that production of manned bombers and interceptors, as well as ballistic missiles, could be increased to bolster the Strategic Air Command's deterrent power while space vehicles and other future weapons are being developed.

The witnesses testified that at least some reorganization of the U. S. defense establishment is needed in order to "get the job done."

Sen. Lyndon Johnson (D.-Tex.) subcommittee chairman, listed 11 criticisms of the present defense structure which, he said, the witnesses blamed for the U. S. lag. They are:

- **Too many committees.**
- **Too many study groups.**
- **Too many layers** of authority.
- **Too many changes** in programs.
- **Too little discretion** allowed industry and military contracting officers outside Washington.
- **Lack of funds.**
- **Overtime restrictions** imposed upon manufacturers.
- **Delays in budget** procedure.
- **Too complex and disorganized** organizations within the Pentagon itself.
- **Confusion as to priorities** on weapons systems.
- **Unwillingness to accept** and to act on the facts of Soviet military strength.

Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, however, told the subcommittee that, "We are not at the disaster point now and by increasing our effort on sound programs which have been developed over the years we can protect the future."

Twining Testifies

Gen. Twining said production figures of the Northrop Snark, the intercontinental ballistic missile and Convair's B-58 supersonic bomber are good and that a decision to increase the number of Boeing B-52 bombers is under consideration, although there is no new money for this in the Fiscal 1959 budget requests.

Under questioning by subcommittee members, Gen. Twining testified that there had been no acceleration in B-52 or KC-135 jet tanker production since Sputnik and that priority of funding had forced a cutback in Snark production earlier.

He said the Air Force had wanted additional funds for more B-52s, KC-135s and B-58s as well as an increase in IRBM's and ICBM's.

Industry Representatives

Industry representatives criticized the red tape involved in the production of weapons and said far more can be done now at relatively low cost than what is presently authorized. They included:

- **Thomas G. Lanphier, Jr.,** vice president of Convair Division, General Dynamics Corp. Lanphier charged that production of conventional bombers, which will still be needed for years to come, is being neglected because of "over-optimism" about reliability of ballistic missiles.

"Manned fighters and bombers and missiles associated with our defense today," he said, "are suffering for attention as the more glamorous ballistic missiles of tomorrow enjoy popular emphasis in the budget now being considered."

Lanphier told the subcommittee that

DONALD W. DOUGLAS, SR.

Convair could produce many more weapons than it is now being asked to deliver and, in most instances, deliver them sooner. He added that the only acceleration of Convair programs since Sputnik has been in the Atlas intercontinental ballistic missile and that the rate of increase here is far less than Convair's capabilities.

- **Krafft Ehricke,** Convair's chief planner for space and satellite development. Ehricke told the committee that existing rockets should be used to put a considerably heavier satellite than Sputnik II into orbit and to launch a manned satellite. Nuclear rockets, he said, could be used to land on the Moon and put reconnaissance vehicles onto Mars and Venus.
- **William M. Allen,** Boeing Airplane Co. president. Allen said Boeing could produce more defense weapons at a faster rate than now authorized. These include:

KC-135—near capacity at present time but could be accelerated.

Bomarc ground to air missile—could produce more and faster.

B-52 bombers—phase out has begun, and Boeing could be producing substantially more.

Allen also said he felt the present national income is insufficient to meet the increased spending necessary to preserve peace and that the country should expect an increase in taxes.

- **Donald W. Douglas, Sr.,** Douglas Aircraft Co. board chairman. Douglas told the subcommittee he felt the Nike Zeus anti-missile warranted a go-ahead

KRAFFT EHRICKE, Convair's chief planner for space and satellite development, tells the Senate Preparedness Subcommittee existing rockets could launch manned satellites.

nearly two years ago that, but so far only a small fraction of the necessary funds has been made available. As for the Thor intermediate ballistic missile, Douglas said production could be accelerated to almost any degree which might be necessary.

• **Donald W. Douglas, Jr.,** Douglas president, told the subcommittee U. S. airlift capacities are wholly inadequate. He said there is a four-billion ton-mile deficit now and that, in the event of an emergency, it would be even greater.

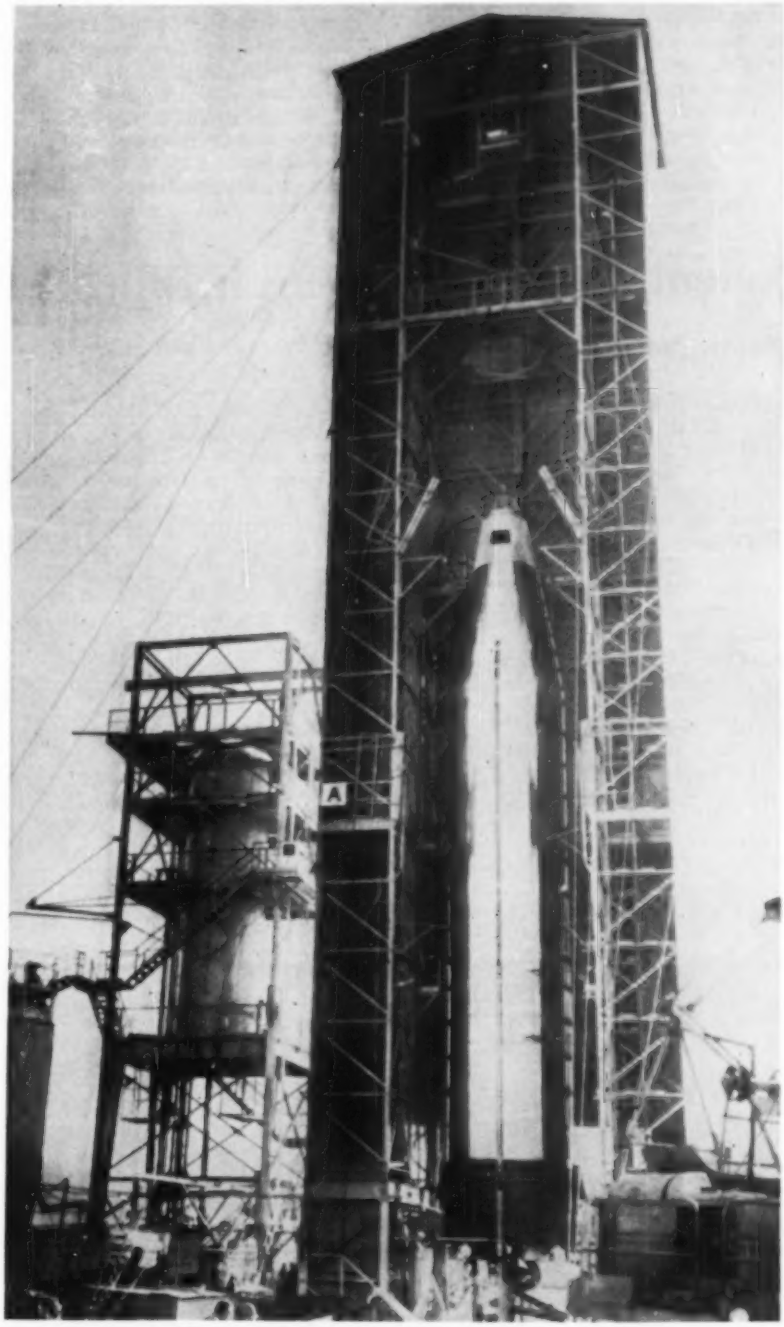
• **Roy T. Hurley,** Curtiss-Wright Corp. president and board chairman. Hurley charged that the U. S. is spending money "for which we are getting too little, too late so far as defense is concerned." He said the Air Force is still buying equipment that was considered obsolete by Russian standards three years ago. Hurley said he was told at an Air Force meeting three years ago that all but two types of power plants being purchased and built in the U. S. were obsolete by Russian standards.

"To date," he said, "all procurement has been directed toward what was then stated to be obsolete, and no procurement has been initiated for the two types considered superior."

• **Whitley C. Collins,** Northrop Aircraft president, told the subcommittee that if the Snark subsonic guided missile had been ordered into production in 1955 the U. S. would have a weapon in inventory which the present Russian Defense system could not stop.

• **J. H. Kindelberger,** board chairman of North American Aviation, testified that it will be several years before the U. S. has a completely reliable missile. He said it takes from two to three years to get the "bugs" out of an airplane, but that, because of their short flight time, it will take much longer to prove out missiles.

Kindelberger said new fuels being developed, such as fluorine fuels now being tested by North American's Rocketdyne Division, will permit the use of smaller rocket engines and substantially improve the thrust/weight ratio. The North American board chairman also predicted that manned bombers and interceptors will still be in use by 1970.



Atlas Integral Propellant Tank

Integral propellant tank, representing about 90% of the Convair Atlas intercontinental ballistic missile configuration, is shown for first time in test tower at Pt. Loma, Calif.

Rocket Firm Plans Gas Company Alliance

Grand Central Rocket Co., recently mentioned as a promising candidate for a corporate alliance (AW Jan. 20, p. 34), appears headed that way.

Caught in a survival squeeze between big competitors that keep getting bigger, Grand Central will cede a majority interest to Tennessee Gas Transmission Co. of Houston in exchange for 60,000 shares of the latter's 5% cumulative convertible second preferred stock, according to a letter of intent signed last week by Tennessee Gas Transmission.

But the real significance of this consolidation, said Grand Central President C. E. Bartley, is that the enormous resources of Tennessee Gas Transmission will put Grand Central into the front line of major producers of solid propellants and solid rocket motors.

Grand Central wanted the merger because of the growing emphasis on big solid rockets and the large resources needed to produce them. To get government contracts, a potential producer often has to prove that he has the financial wherewithal to see him through.

Grand Central believes that its

merger with Tennessee Gas Transmission Co. will provide this, as well as the means to get some already planned expansion under way.

The scheduled alliance is not expected to make any change in Grand Central's basic philosophy (AW Dec. 23, p. 37).

The company plans to remain essentially a manufacturer of solid rocket engines and does not expect to go into airframes, guidance or systems management operation.

Tennessee Gas Transmission Co.'s role, as presently envisioned, will be to provide money and not facilities. It is possible, however, that the company will get into basic fuel research at some future time, since it already has the necessary organization and equipment.

Scientists Back Research Bill; Say Security Curbs Progress

Washington—Congressional concern over the status of U.S. science and technology and its determination to do something about it was demonstrated on three fronts last week:

• **Two top scientists** gave qualified approval to the proposal of Rep. William Dawson (D.-Ill.) to establish a $200 million Scientific Research Reserve Fund that could be used to finance high priority projects without the delaying processes of budgetary red tape (AW Jan. 20, p. 25). The scientists were Dr. Alan T. Waterman, director of the National Science Foundation, and Dr. Detlev W. Bronk, president of the National Academy of Sciences and chairman of the National Science Board. Dawson is chairman of the House Government Operations Committee which has jurisdiction over the organization of federal departments and agencies.

• **Sen. John McClellan** (D.-Ark.), chairman of the counterpart Senate Government Operations Committee, and Sen. Hubert Humphrey, chairman of its Subcommittee on Government Reorganization, introduced legislation establishing a Department of Science and Technology for the centralization and coordination of civilian science functions. As drafted, the bill would transfer to the new department the present functions of National Science Foundation, the Patent Office, several branches of the Commerce Department, the National Bureau of Standards and the Atomic Energy Commission. The sponsors, however, emphasized that the legislation is simply a "vehicle" for hearings, at which time inclusion of the National Advisory Committee for Aeronautics in the new department will be considered.

• **Three science leaders aided** the House Subcommittee on Information in its bid to ease security regulations which it says curbs the flow of scientific information among scientists and to promote a comprehensive system of translation, indexing and abstraction of technical material. The scientists were Dr. Lloyd V. Berkner, president of Associated Universities and vice president of the International Coordinating Committee for the International Geophysical Year; Dr. Donald J. Hughes, senior physicist at Brookhaven National Laboratories who recently completed a month's lecture tour in Russia and the satellite countries, and Dr. Wallace R. Brode, president of the American Assn. for the Advancement of Science, and new science adviser to Secretary of State John Foster Dulles (AW Jan. 20, p. 25).

Berkner recommended—and Brode subsequently endorsed the proposal—that a small area of information which should have secret classification be established and that all other information, now under various shades of classification, be released. Berkner urged the appointment of a special commission with representation from the legal, academic, business and scientific professions to determine the small area of information that should be classified.

Business Representation

He stressed that business should be represented because he said, the value of what commercial firms might accomplish from the release of new information should be weighed against the advantage of keeping such information under lock and key. He added that the present over-classification defeats its purpose because it tends to devalue the rigid classification which should be maintained "on some secrets which should be kept in the national interest."

The three scientists vigorously protested the present requirement of separate security clearance by different government agencies. Hughes, a nuclear physicist with the Atomic Energy Commission security clearance, pointed out that he had been handicapped in performing special technical tasks for the Air Force because he was denied information as to the objective of the tasks and could not discuss the projects with his colleagues who did have USAF clearance. "Multiple security clearances are not only a nuisance, but by mere duplication have been known to result in conflicting determinations," Brode said.

The three scientists also called for prompt establishment of a centralized system for translating, abstracting and indexing technical information—a counterpart to the Soviet Institute of Scientific Information founded in 1953. Hughes reported that, after a first-hand inspection of the Soviet institute, that it is "doing a tremendous job." Hughes said that there is still an approximately

LEADING scientists talk with Rep. John E. Moss (D.-Calif.), Chairman of the House Government Information Subcommittee. Left to right: Dr. Donald J. Hughes; Dr. Wallace R. Brode; Dr. Lloyd V. Berkner and Moss.

ten-month lag between the original publication of technical information and its wide dissemination in abstracted form in Russia, but that this lag is continually being cut.

'Secrecy' Overworked

Highlighting the importance and gigantic scope of a project to establish a centralized scientific information clearing house, Brode noted that "with about half a million scientific articles published this year, it is just humanly impossible for a single intellect to cope with this amount of information."

Under the present confusion, Berkner reported that one Russian technical article was translated by seven different U.S. agencies and then stamped "secret." Berkner, noting that Russia this year is spending $4.5 billion on research and development, said that "with this effort, it is obvious there shall be a vast amount of technical information which could be translated and disseminated for the benefit of U.S. scientists."

Russia has said it will have an electronic machine for the mechanical translation of scientific articles by the fall of this year, but Berkner put the development of mechanical translation "in the far future" because of the varying modes of expression in different languages.

Berkner also criticized the relatively small amount of research work now being conducted in U.S. universities on solid rocket fuels. He reported that Japan is emphasizing this area of research but that the Japanese technical findings are not being made available in the U.S. simply because of the mechanical problem of translation and dissemination.

What Is Needed

Recommendations by Berkner, which he said "would yield benefits far in excess of the costs involved," included:

- **"Immediate support** through the National Science Foundation of scientific journals and specialized publications to permit and encourage prompt and full scale publication in our language of scientific literature and provide for its adequate abstracting.
- **Provision for encouragement** and financing of government research papers in recognized scientific journals, discouraging unnecessary use of the "government report" of scientific research.
- **"Support for international activities** in publication of international scientific symposia and standards, and of the international effort to improve publication of abstract journals;
- **"Subsidy of an adequate** effort of translation of non-English scientific papers, unification of translations sponsored by the several agencies, and prompt publication in journals regularly accessioned by the libraries.
- **"Immediate initiation of substantial** and continuing research on procedures of subject-classification, indexing, and retrieval, looking to adequate means of providing to U.S. and other western scientists full access to the scientific literature of the world."

Next Generation Seen As Missile Race Key

New York—Present generation of United States ballistics missiles can be compared to the Model T, according to Major General Bernard A. Schriever, head of the Air Force ballistic missile program.

It is also a lost generation, the general said. If this country is to catch up with or surpass the Soviet Union in the field of ballistic missiles, it will have to look to the next generation of missiles. And the time to make decisions to design, develop and produce this next generation of weapons is now. The Air Force, he noted, already has a good idea of what the second generation will look like.

This means, General Schriever said in a speech before the Economic Club of New York last week, that 1968 has to be as real in our thinking as 1958. It means that the Air Force must continue to take the calculated risk of planning, programming and spending funds, concurrently, on research, development, testing, production, manpower training and base construction.

This unique management concept of concurrency which pervades the Air Force ballistic missile program, he said, has been perhaps unduly overlooked but cannot be overemphasized. The value of this concept is dramatically illustrated by the case of the Thor missile. The first Thor rolled off the production line only 11 months after the Air Force received Defense Dept. approval to begin the project. And, Gen. Schriever said, the Air Force Ballistic Missile Division has every confidence that a completely operational Thor squadron will be ready for overseas deployment by December, 1958, 36 months after start of the project.

The same calculated risk must be taken in all major development programs if the U.S. is to regain its technological lead. The United States today has the basic propulsion capacity to put a manned artificial satellite in orbit around the Earth; and, said Gen. Schriever, there is no reason why the Russians should beat us at this.

At the same time, he pointed out, the U.S. will have to keep on refining and improving its present, comparatively primitive ballistic missiles. They will have to be produced at less cost and will have to be made more accurate, more reliable, and less complicated. Initially, the ballistic missiles can be expected to hit the target only about 50% of the time. But the general estimated that eventually this accuracy will run 70-90%. Improvements in all subsystems such as guidance, warheads and nose cones are under development.

Looking into the future of ballistic missiles, Gen. Schriever saw reductions in size, greater accuracy, solid propellants, storable liquid propellants, and thermonuclear engines. The thermonuclear rocket, he said, is definitely farther away than the others, "but the program should be pushed hard."

Israel to Get Vautours

Paris—French government is quietly preparing to turn over a portion of its twin-jet Vautour jet bombers to Israel.

No official announcement is expected to be made of the transfer. Israeli pilots already are being trained on the Vautour at the French air base at Tours, where the first French Vautour squadron is based. French Air Ministry has about 150 Vautours on order of which reportedly 35 have been delivered.

Original Vautour order was for several hundred but this was cut back last year as a result of a budget squeeze. It is understood Israel will get an undetermined number of French-ordered aircraft.

Vautour S.O. 4050 subsonic jet bomber is built by Sud-Aviation and powered by Snecma Atar turbojets rated at about 7,700 lb. thrust. Developed in three different versions—ground attack, bombardment and all-weather fighting—Vautour currently represents the only jet bomber available to the French air force. Actually, most of the 35 aircraft already delivered to the French air force are all-weather fighter type. First French air force Vautour squadron at Tours is 30th All-Weather Fighter Squadron.

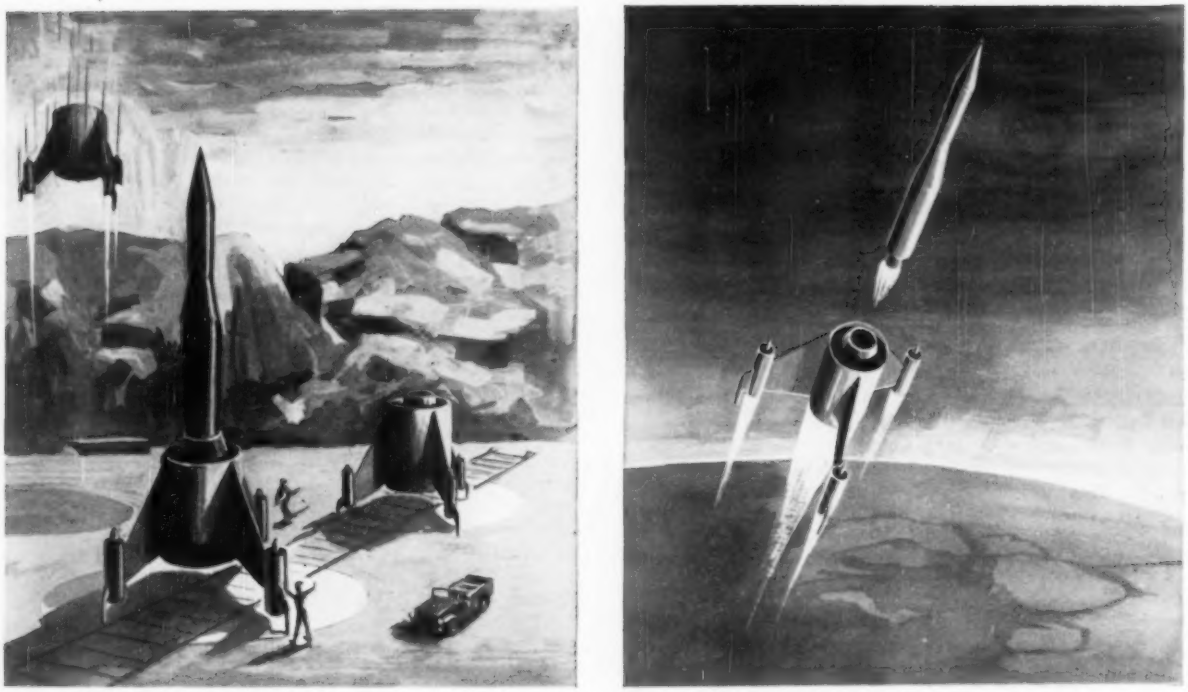
Martin YP6M Begins Flight Test Program

Middle River, Md.—Flight test program on Martin's P6M jet seaplane was resumed last week with the first flight on the YP6M.

Program was delayed for over a year following the crashes of the first two XP6M prototypes. Second prototype crashed on Nov. 9, 1956.

YP6M incorporates a redesign of the tail assembly's hydraulic system. Malfunctions in the tail system were blamed for the two prototype crashes.

Last week's flight of the Chesapeake Bay area lasted for almost two hours and followed several weeks of taxi tests. Pilot was George A. Rodney, Martin's chief experimental test pilot.



GENERAL ELECTRIC CO. proposal for turbojet-powered first stage is shown separating from solid fuel ballistic missile (right) after carrying the weapon to great altitude and at speed of better than Mach 4. First stage then returns to the launching site (left) by auto-pilot as other missiles are readied. The recoverable and self-transporting nature of this air-breathing boost equipment will reduce the cost of ballistic missile systems, according to company studies. Total system weight would be reduced because the first stage oxidizer load is eliminated by the turbojets which use the oxygen in the atmosphere.

Turbojet May Serve as ICBM Booster

Cincinnati, Ohio—Recoverable turbojet-powered first stage boosters for ballistic missiles and orbital rockets have been proposed by General Electric Co. to make current systems more economical.

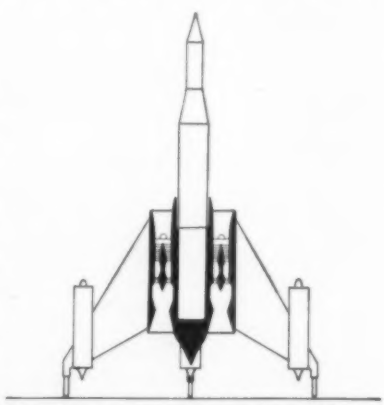
Turbojet engines specified in the proposal would have about 25,000 lb. trust without afterburning and operate to Mach 4 and better. General Electric indicates they are the next logical step in turbojet development after engines such as the J79.

Main Design Criteria

The company believes they will be no more difficult to develop than present-day engines and that the necessary high temperature components can be built.

As the engines would not be required to cruise, the main design criteria would be to provide optimum operation in the region around Mach 2 where engine performance is especially sensitive to inlet and exhaust nozzle adjustment and vehicle drag is usually the highest. Good acceleration through this speed range is necessary if fuel load and total system weight are to be kept low. After a speed of Mach 3 or so is reached, the compressor and turbine would be bypassed and the engine would operate as a ramjet.

The vehicle configurations shown here have been suggested by General Electric only to illustrate its concept and in the course of a development program the arrangement probably would change. Preliminary design studies have shown, however, that the weight of the turbojet booster for the first stage is estimated to be 50% of takeoff weight. First stage fuel weight would be 10 to 15% of takeoff weight.



POSSIBLE engine arrangement would have nine turbojets clustered in the centerbody and three on outriggers for control.

The Russians also are believed to be considering air-breathing engines as a stage in large rocket systems so that part of the oxidizer load can be replaced by oxygen in the atmosphere. Russian ideas, however, evidently tend to use of second stage ramjets which are boosted quickly to speed by a first stage of solid fuel rockets. Recovery and quick re-use of such equipment would seem difficult.

Primary Advantage

One primary advantage of the General Electric air-breathing boost system is that they can be flown by themselves. They would not require transportation or ground handling equipment, greatly facilitating missile dispersal.

Along with the company suggestion for air-breathing boost for more economical missile systems, the Mach 4 turbojet is being pushed for manned aircraft. Turbojet experts are agreed that useful operation of this powerplant can be extended to Mach 4 and better, and that the versatility of future manned aircraft will suffer greatly if this engine is not developed.

Radio Technique Tracked Sputnik During Final Disintegration Period

Columbus—Technique developed to count meteor trails tracked Sputnik I during its two week period of disintegration until the fall of the last fragment, according to scientists of Ohio State University's Radio Observatory here.

From the time that its 20 and 40 mc. transmitters failed, Sputnik I was tracked by detection of signals transmitted on 20 mc. by WWV, National Bureau of Standards station near Washington, that were reflected from the ionization column generated as the satellite sped through the relatively thin upper atmosphere.

The observatory has tracked both Sputniks I and II by reception of their telemetered transmissions, and is continuing to follow Sputnik II with the reflection technique, under direction of Prof. John D. Kraus. The reflection technique originally was developed for counting meteor trails by Prof. L. S. Wylie and H. T. Castillo of Wittenberg College.

Sputnik Timetable

Toward the end of December the average height of Sputnik I's orbit was about 180 mi., with perigee about 130 mi. and apogee about 250 mi. During this time its period of revolution began to diminish rapidly, about 25 sec. a day, and three targets were detected in place of one. The timetable after that was:

- **Jan. 4.** Two of the three fragments showed signs of further breakup. Time between passage of the first and last fragments was eight minutes. This is the date given by the Soviet news agency Tass for the fall of the satellite.
- **Jan. 6.** At least eight fragments were detected in orbit. Time between first and last fragments was 30 min.
- **Jan. 7.** Seven fragments detected.
- **Jan. 8.** Four fragments detected.
- **Jan. 9.** One fragment detected.
- **Jan. 10.** No signals observed.

Shortly after Sputnik I was launched, the observatory assembled a simple radio telescope for tracking the telemetry signals on 20 and 40 mc. It consisted of two dipole antennas set up about 350 ft. apart on an east-west line. The resulting pattern was a series of fan shaped lobes running north and south.

In the vertical plane the two antennas added in phase to give a maximum, with other maxima at intervals of 6 deg. in both directions. In addition to use of interferometer techniques, the satellite altitude was obtained from time of passage from one maximum to another and the period of revolution.

An unusual effect was noticed as the satellite approached. The signals faded rapidly and became very unsteady until it reached a position where the angle between the line of sight and the orbit was approximately 60 deg. Whereupon the signals became smooth and steady.

One hypothesis is that the satellite swept up ionized particles in front of it or ionized air molecules by collision.

Reflection Method

Basic limitation of the reflection technique is that it operates only during hours when the 20 mc. WWV signal is not being reflected by the ionosphere to a significant extent. As the ionosphere rises in altitude at night, the electron density becomes lower with a consequent lowering of the upper reflected frequency limit.

The strong reflection from meteor ionization trails lasts for 2 or 3 sec. and the even stronger returns from satellite ionization trails last from 1 to 2 min., which suggests a high charge density.

At 5:55 A.M. on Jan. 4 the pilot of a Navy R5D, Marine Capt. Donald Parrill, was awaiting takeoff instructions at Columbus Airport when he saw "a yellowish to orange-red object" that was very bright and traveling at great speed. It was also seen by another Marine officer and a Navy technician accompanying him.

The object was in sight for 10-15 sec. during which he called the tower operator who saw it and entered it in his log. They noted that it appeared to turn a darker red color as it receded. The time of sighting was later found to check with that of Sputnik I's passage.

Because aluminum does not become incandescent upon heating, the object was not part of the satellite's outer shell or simply was reflecting sunlight. It could, however, have been a fragment of the interior structure.

Once a satellite has been holed by a meteorite or the skin punctured by aerodynamic heating, it will disintegrate fairly rapidly because of the "dumbbell effect." This states that if a dumbbell-shaped object that is traveling broadside is subjected to aerodynamic heating the large areas will withstand heating better because they will be better able to conduct it away. The small joining piece will disintegrate first because of its restricted conduction path.

Translation Plan

Washington—Commerce Department last week announced plans for the establishment of a foreign technical information program to compile and distribute translations of available Soviet technical literature.

The program, similar to one proposed by U. S. scientists (see page 34), is scheduled to "publicly distribute" approximately 50,000 abstracts and 10,000 complete translations annually, including articles from "200 important Russian scientific journals."

Fairchild VTOL Design

Artist's concept of an Army VTOL research aircraft now being developed by Fairchild. Designated the M-224-I, the plane achieves maximum lift by means of a vectored slipstream. Initial flights are scheduled to take place late in 1958.

Airlines Prod Board for Higher Fares

Carriers begin new drive for increase in rates; American asks 15% boost, an end to CAB hearings.

By L. L. Doty

Washington—Scheduled airlines last week renewed their drive for higher revenues with a flurry of requests for fare increases, each varying in scope but all designed to arrest what one airline termed the "alarming deterioration" of the industry's financial condition.

In an unprecedented action, American Airlines coupled its request to the Civil Aeronautics Board for a 15% fare increase "at the earliest possible date" with a motion urging that hearings in the current passenger fare investigation be brought to a halt when the present session on rates of return is completed. The rate of return phase is the first of three comprising the investigation which is now in its ninth week and is expected to continue through to early 1959.

In another unexpected move, Trans World Airlines called for a complete overhaul of the fare structure by establishing basic per-mile first-class and coach rates. Late last week, Capital indicated it intends to file a similar tariff. At least three other trunklines were expected to ask for 12½% increases with varying conditions.

Why the Rush

The sudden rush of tariff filings was sparked by an earlier petition to the Board from Continental Air Lines asking for a 15% fare increase effective Feb. 1 and continuing until 30 days after the Board's decision in the General Passenger Fare Investigation (AW Jan. 20, p. 47). TWA wants its fare adjustment to be effective Mar. 1. American stated it would file for an increase at "the earliest possible date."

American's two-pronged action and TWA's plan for a revised fare structure underscore industry-wide impatience with the slow progress of the fare investigation and the grim outlook most airlines see for immediate relief from the current profit squeeze (AW Dec. 30, p. 39). The actions, however, reveal sharp variances in opinion among the individual carriers as to just what is the best method of solving the fare problem.

Airlines will stand behind any fare increase, but it is unlikely that either American's motion for an end of the case or TWA's fare realignment proposal will draw undivided industry support. Privately, a number of airline officials fear that both carriers have been too drastic in their moves for corrective action at this stage of the investigation. They fear the proposals may divert and delay the General Passenger Fare Investigation just as the request for a 6% fare increase last year and the resultant suspended fare investigation sidetracked the general fare case for six months.

Risk to Board

According to one airline official, the Board will be unable to cut its investigation short without running the risk of a congressional inquiry. He pointed out that the Board is virtually under mandatory orders from Congress to conduct a full-scale investigation of fares before making any decision on a fare revision.

The present investigation was prompted by pressure exerted in 1956 by the House Antitrust Subcommittee during hearings on airline activities. At that time, one subcommittee member called earlier failure of the Board to look closely into airline fares a "scandalous abdication of responsibility."

Some airlines, however, feel that the first phase of the investigation—the rate of return phase—has detailed the need for a fare increase well enough to serve as a sound basis for a Board decision. The introduction of financiers, bankers and investment brokers as witnesses, they add, has provided the Board with an unprecedented volume of material to support the airlines' case.

The second phase of the investigation will cover the carriers' forecast during the next five years of equipment needs and financial requirements.

Advocates of the American proposal say this has been accomplished in large during the first phase.

Third phase of the investigation has been labeled "all other" and will cover facts not handled during the first two phases including "elasticity of traffic demand."

Specifically, American has filed a motion asking the Board to take three steps toward expediting the fare case:

- **Instruct the CAB staff** and the examiner hearing the case to take every possible step towards bringing the hearing to an end within one month after the close of the rate of return session.
- **Direct that the case** then be certified directly to the Board for final decision.
- **Direct that briefs** are filed with the Board by all parties within two months after the close of the hearing and that the case be set for argument immediately thereafter.

American said that such action would allow the case to be concluded by May or June of this year. The investigation was first begun in May, 1956.

The airline pointed out that the Board had issued a decision and opinion in the Air Freight Rate Case "within little more than six months after the case had been instituted despite the fact that that was the Board's first experience with a full-scale rate case. . . ."

It pointed to the volume of exhibit material, written testimony and cross-examination produced in the rate of return phase of the investigation and said, "The question of allowable or needed earnings for a regulated enterprise probably has never received such full treatment as . . . in this case."

American emphasized that the Board's staff has had possession of much of the exhibit material since February, 1957, and added:

"There is not the slightest excuse for not having tightly organized and precise cross-examination, strictly confined to the single purpose of disclosures of relevant and material facts."

'Voluminous Information'

Admitting to a possible difference of opinion between the carriers and staff members on certain issues, American said "the basic facts upon which judgment must be applied in the resolution of these issues are not seriously in dispute."

American also answered airlines who fear the renewed request for a fare increase might result in another suspended fare case by stating:

"The Board is not required to suspend the tariff increase, which American will file, and it is urged not to do so. As a result of the data filed in this investigation since the decision in the suspended passenger fare case last August the Board has voluminous information on the industry's economic condition and on the alarming deterioration in its financial standing and hence is extensively informed on the carriers' needs for increased fares."

TWA's petition for equalization of fares called for a basic first-class fare of 6.7 cents per passenger-mile and a tourist fare of 4.7 cents. According to Warren Lee Pierson, TWA chairman and acting president, the new TWA

tariff would provide passenger revenues increases for all airlines ranging from 0.6% to 8.5%. For TWA, the increase would be 5.9%, Pierson said.

In emphasizing the present inequality of fares in the overall airline fare structure, Pierson said that the first-class passenger flying the 1,100 mile route between New York and Miami pays seven cents per mile compared to the New York-Minneapolis passenger who pays six cents per mile for 1,020 miles.

Pierson said the revised fare pattern would result in decreases on about 12% of TWA's domestic trips while the balance of the carrier's operations would undergo a fare increase. TWA emphasized that the present filing is unrelated to the present general fare investigation.

In the past, several suggestions have been offered for revising the fare structure. At one time, Delta Air Lines proposed that each fare be rounded out upward to an even dollar figure as a means of reducing accounting and auditing costs as well as simplifying fare presentation to the traveling public.

Although the proposal was rejected by the Board, Braniff is considering filing a request for a 12½% increase rounded-out to the next highest half-dollar. Sharpest inequities in the basic fare structure exist on the non-competitive routes of the local service airlines where the Board usually grants a fare construction that will help offset subsidy costs without deterring traffic demand.

Under the present fare pattern, there are no minimum or maximum fares and the fare structure is determined entirely by the Board's acceptance or rejection of tariffs filed with them by the carriers through the Air Traffic Conference of America.

Bristol 200 Short-Range Jetliner Designed to Carry 99 Passengers

London—Bristol Aeroplane Co. has released some details of the Bristol 200 short-range jet airliner, an aircraft designed to carry up to 99 passengers over ranges between 300 and 1,700 mi.

A sales and engineering team from the newly-formed partnership of Bristol and Hawker Siddeley Group (AW Jan. 13, p. 39) now is in the United States to visit U.S. airlines with detailed operating analyses of Bristol 200 performance on a number of U.S. domestic routes.

The short-range jet initially was designed to specifications laid down by British European Airways.

Extended government talks on British European Airways' controversial contract for a short-range jet airliner still were deadlocked last week.

Final decision had been expected at a meeting between BEA Chairman Lord Douglas, Minister of Supply Aubrey Jones and Minister of Transport and Civil Aviation Harold Watkinson. Only announcement following the session, however, stated "some progress" has been made.

A BEA spokesman said the ministers were being "pretty tough" and a de Havilland spokesman said things were looking "somewhat better." BEA has been holding out for the de Havilland 121 while the government has favored the Bristol 200, proposed by the Bristol-Hawker Siddeley partnership.

A compromise proposal that Bristol join de Havilland in building the 121 has been rejected by Bristol. An informed source said present stumbling-block is the question of whether de Havilland can provide the financial strength the government feels is desirable. The Bristol-Hawker Siddeley combination obviously is much stronger in this respect.

Design of the 600-plus mph. airliner provides three engines mounted on the aft fuselage. Center engine of the cluster is set at the fin root atop the fuselage. The jet pipe for the center engine passes through the tail fin. The engine itself, however, is mounted forward of the vertical stabilizer. Port and starboard engines are set slightly ahead of the upper engine and well above ground level.

Provision is made for Bristol Olympus engines and the manufacturer is prepared to accommodate the Rolls-Royce bypass Conway or other engines specified by the customer.

The 79 to 99-seat airliner has a 91-ft. wing with a 30 deg. sweep at the quarter chord line.

Fuselage length is 121 ft. 6 in. Overall height is 28 ft. 3 in.

It is designed for high-speed cruising at 25,000 ft. and long-range cruising at 36,000 ft.

With a design maximum gross weight of 120,000 lb., the airliner will carry 21,000 lb. of payload.

Bristol says the fundamental design consideration has been the exceptionally high power-weight ratio which enables the aircraft to climb at a speed only slightly below its cruising speed. It also will make possible the use of smaller airfields, the company says. Takeoff field length is believed to be in the neighborhood of 5,800 ft.

The Hawker Siddeley Group has disclosed that while the Bristol-Hawker sales team is in the U.S., other Hawker Siddeley executives have arrived in New Zealand for sales talks on the Armstrong Whitworth AW-650 turboprop freighter.

After talks in Wellington, the team will go on to Australia.

The Bristol-Hawker team in the U.S. is led by Dr. A. E. Russell, chief engineer of the joint company set up by the two firms for development of the new short-range jet airliner.

The New Zealand party is headed by C. S. Emery, sales director of Armstrong Whitworth. Ten of the new freighters are under construction at the firm's Coventry factory but no orders have been announced yet.

The Armstrong Whitworth sales team will visit South America and the Far East after returning from Australia.

The AW-650 is designed to fly up to 2,000 mi. at 300 mph., carrying a payload of 28,000 lb. It is powered by four Rolls-Royce Dart Engines.

23 Caravelles on Order

Paris—Orders for Sud-Aviation's medium range twin-jet Caravelle passenger liner now stand at 23 following a recent order for three aircraft by Finnair.

Delivery of the Finnair order is slated for February, March and April 1960. Line expects to use the Caravelle on its Helsinki-Moscow service.

Finnair also placed an option on three aircraft, bringing the total number of Caravelle options to 37.

Sud-Aviation is expected shortly to announce further orders, with the most likely candidates being Air Algeria for three Caravelles and Air Maroc for two. First two of 12 Caravelles ordered by Air France are slated for delivery late this year.

United's Net Halved; Costs, Fares Blamed

United Air Lines' net earnings dropped 53% last year from a 1956 total of $10,341,137, the company reported. The 1957 total net of $4,865,648 was augmented by aircraft sales equal after tax to $3,022,655. Together the 1957 net incomes were equivalent to $2.38 per share.

The 1956 equivalent was $4.57 per share.

The carrier's 1957 revenues were 7% over the previous year for a total of $281,946,519.

United President W. A. Patterson attributed the 1957 earnings decline to "the squeeze of further price rises and fares held at low levels."

Convair's F-106A is equipped with the most advanced electronic fire control and armament ever developed for an Air Force interceptor. Built by Convair Division of General Dynamics.

The new "Delta Dart"...

Fastest all-weather interceptor ever flown!

Her Pratt & Whitney J-75 turbojet has been rated as the most powerful production engine in the free world. And it uses afterburning for extra power.

Nickel alloy picked for afterburner shell

Pratt & Whitney picked Nimonic "75"* nickel-chromium alloy for the afterburner shell of the J-75. This Inco Nickel Alloy provides the strength and corrosion resistance needed in this critical high temperature assembly. Nimonic "75" is also relatively easy to fabricate – an important factor in a production engine.

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Decca to Be Evaluated For Helicopter Use

Bendix-Decca low-frequency hyperbolic navigation system will be evaluated as a helicopter navigation aid to the New York area, beginning around April, Airways Modernization Board announced last week. Decca proponents say the system's low-altitude area coverage and extreme accuracy make it ideally suited for helicopter operations.

Four organizations will participate in the evaluation:

- **New York Airways** helicopters will fly airborne Decca log–pictorial display –on scheduled flights.
- **Pacific Division of Bendix Aviation** will furnish, install and maintain equipment.
- **Airborne Instruments Laboratory** will provide engineering assistance and measure system performance.
- **Bell Helicopter Corp.** will install advanced instrumentation in a special Airways Modernization Board test helicopter to be flown by AMB pilots in evaluating feasibility of instrument flight with Decca system.

Airways Modernization Board Chairman E. R. Quesada said selection of Bendix-Decca was made because of its immediate availability and does not represent an AMB endorsement over other hyperbolic systems like Loran-C and French Radio Web.

Unrealistic Scheduling Charged by CAB

Washington—Six domestic airlines were accused by the Civil Aeronautics Board's Office of Compliance last week with failing to operate flights in accordance with published schedules.

In issuing the complaints, the compliance office bypassed the Board's highly controversial "unrealistic scheduling" regulation (AW Jan. 13, p. 43) and turned to section 411 of the Civil Aeronautics Act covering "unfair and deceptive practices." The airlines involved in individual complaints are American, Capital, Delta, National, Trans World and United Air Lines.

The complaints charged the carriers with "filing and publishing schedules which are not reasonably accurate and do not bear a realistic relationship to actual performance thereunder."

Complaints were based on tests conducted by the Office of Compliance during the months of July, 1956, and April, 1957. Tests on American's flights covered coast-to-coast operations and disclosed that the percentage of flights operated under or on scheduled time ranged from 6.4% to 70.3% in July and from 16.6% to 43.3% in April.

The unrealistic scheduling regulation, which went into effect in September and is under attack from the airlines, makes it a criminal offense to fail to operate flights within 15 minutes of published schedules at least 75% of the time.

Capital's flights were tested over various segments of its routes between Chicago-Milwaukee and Washington-Norfolk. Completion of flights on schedule ranged from no times at all on one Viscount flight during the July tests to 42.8% on another flight. In April, the range was from 3.4% to 25.9% on 13 flights tested.

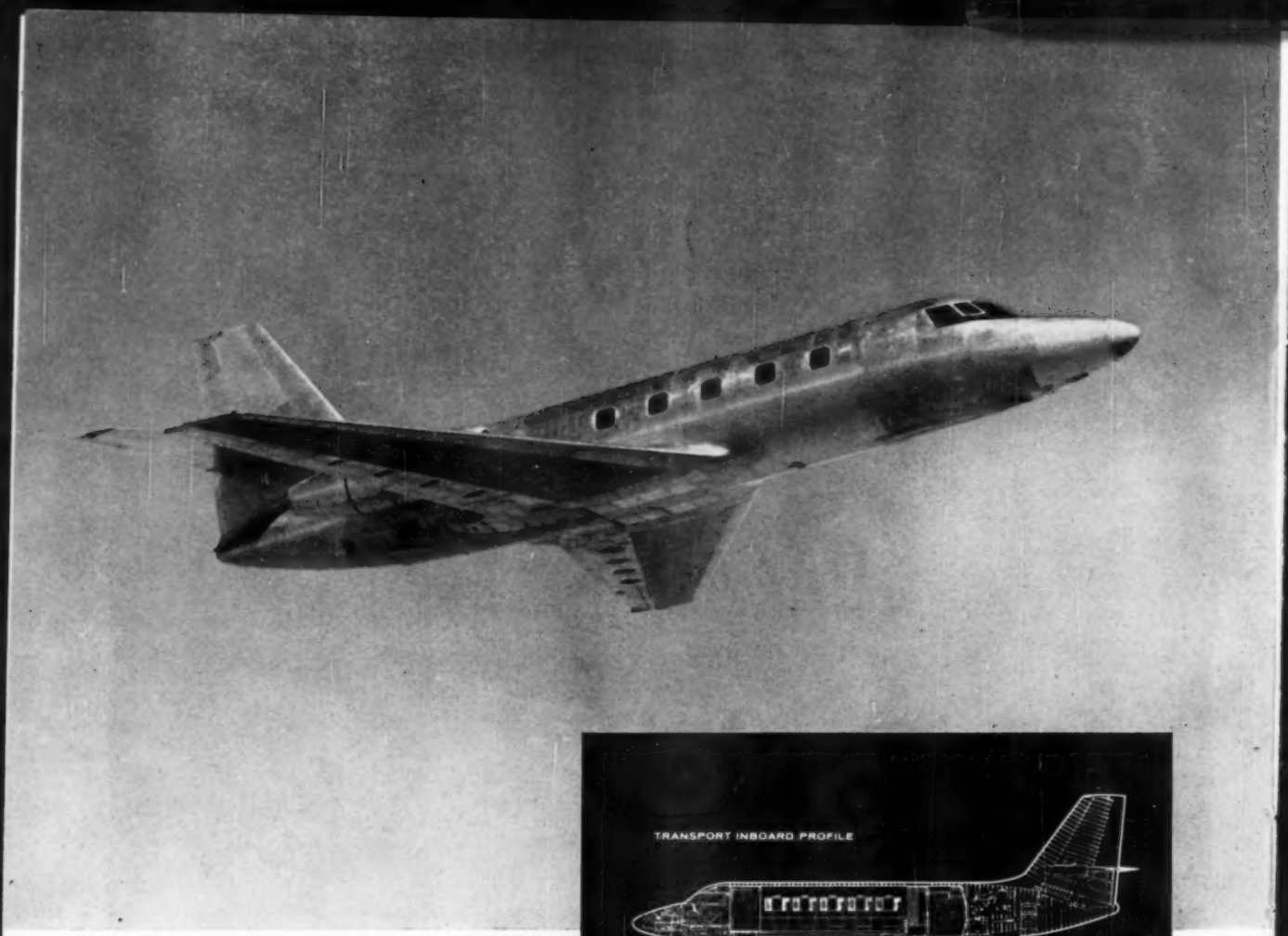
Delta's range ran from 12.9% to 68.9% for July and from 7.6% to 56.6% in April.

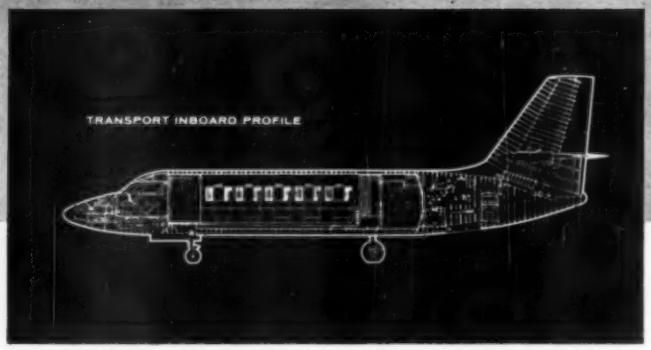
On National's designated flights, the range was from no times at all in both months to 6.8% in July and 37.5% in April.

TWA transcontinental flights checked disclosed that on-time operations ranged from 3.3% to 20% in July and from 14.2% to 56.6% in April. United's flights varied from 26.6% to 56.6% in July and from 34.4% to 55.5% in April.

Breguet Transport Touring Americas

Breguet, French aircraft manufacturer, is attempting to sell the Breguet Deux-Ponts (double decker) cargo transport in the Americas through a U. S. firm, Tri-France, Inc., of Miami. Deux-Ponts first flew in 1951, can carry a payload of 35,000 to 40,000 lb. over stage lengths of 1,200 to 1,500 mi. Ton-mile cost is reportedly less than five cents. Aircraft can carry 135 passengers; empty weight is 71,080 lb. Air France owns 12 Deux-Ponts powered by four Pratt & Whitney R2800-CA18 engines developing 2,400 hp. each. French Air Force has ordered 15 additional Deux-Ponts powered by Pratt & Whitney R2800-CB17 developing 2,500 hp. each. This version, being offered to American buyers, has a marked performance improvement at altitude. Sales price is $1.55 million without radio gear. Pierre Breguet told Aviation Week that his company's agreement with the French Air Force is flexible enough to allow him to offer several positions on the 15 plane production line to prospective customers. Deux-Ponts has visited New York, Washington and Miami; and will visit Caracas, Bogota, Lima, Buenos Aires and Rio de Janeiro.





Now flying—the new multi-mission Lockheed JETSTAR

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Designed for a variety of Jet Age military missions, the Lockheed JETSTAR is a utility jet transport that flies 500-550 mph, at altitudes up to 45,000 feet for distances of 1,800 statute miles or more.

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Like all Lockheed planes, the new JETSTAR is easy to maintain and economical to operate. And it has the inherent stamina to insure optimum utilization and long life—qualities that are more important in military aircraft today than ever before.

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BOAC Views Britannia as Money Maker

By Glenn Garrison

New York—British Overseas Airways Corp. believes its Bristol Britannias will hold their own during the first years of turbojet competition, and that the turboprop Britannias can perform a useful job for the airline for at least 10 years.

BOAC began transatlantic Britannia service last December with a modest once-weekly round trip schedule, is also operating a series of proving flights on the route to train crews and feel out the performance of the long-range Britannia 312 on the Atlantic run.

The British carrier has been flying its medium-range Britannia 102s in scheduled African, Australian and Far Eastern service since last February. Transatlantic service in the 312s will be stepped up this spring as additional planes are delivered. The plane is scheduled to serve San Francisco, Montreal, Detroit and Chicago this year in addition to New York.

Passenger Appeal

In the fall, Britannia will take over BOAC's first class "Monarch" service now provided in Boeing Stratocruisers.

The Britannia has considerable passenger appeal, a flight on a recent proving run disclosed. It is quiet, smooth and comfortable, and generally clips about an hour and a half off the fastest piston times on the Atlantic.

Taking off from New York at a gross weight of 170,000 lb. with 33 passengers and 19 crewmen—10 more than normal, for training purposes—the 312 averaged about 310 kt. of true air speed over the 3,060 nautical mile course for a nonstop time of 8 hr., 30 min. to London.

Landing Weight

Landing weight was 126,000 lb. with 20,460 lb. of kerosene fuel remaining. From Gander to London, the flight was aided by westerly winds up to 100 kt.

Original flight plan called for high speed cruise at an altitude of 23,000 ft. with an estimated flight time of 7 hr., 55 min., but a starting delay changed the wind picture and the flight was made at altitudes of 19,000 ft., 23,000 ft., 25,000 ft. and 27,000 ft. The plane can be operated at altitudes up to 36,000 ft.

On the return flight, the 312 stopped at Gander for crew training reasons. Takeoff weight at London was about 176,000 lb. and the run was made at a constant altitude of 24,000 ft. under high speed cruise procedures. Time was 7 hr., 58 min., just two minutes over the planned flight time.

At the cruise altitude, the plane's true air speed built up from 300 kt. to 335 kt. against headwinds of about 47 kt.

Long range cruise technique with the Britannia involves step climbs of usually 2,000 ft. each as fuel is burned off and speed builds up to VNO (maximum normal operating speed). At 24,000 ft. with standard outside air temperature, the VNO true air speed of the plane is around 340 kt.

A big difference in operating the turbine-powered Britannia is the minimum practical altitude of about 20,000 ft. Fuel consumption jumps sharply at lower altitudes and VNO is lower. Between London and New York, with 100-kt. headwinds at 20,000 ft., a Douglas DC-7C could go down to 10,000 ft. and employ long-range cruise against perhaps a 40 kt. wind. The Britannia, however, would have to remain at high altitude and buck the winds.

BOAC's westbound scheduled flights in the 312s have been able to make it nonstop in every case but one. In that instance, the flight encountered 100-kt. winds between London and Gander and 120-kt. winds beyond Gander. It touched down at Boston.

Although the straight jet Vickers VC-10 may replace BOAC's Britannias sooner (AW Jan. 20, p. 41), the airline is thinking in terms of at least a decade's possible service with the turboprops.

"Our view about this airplane is that it's a very sound piece of transportation," K. G. Granville, BOAC's commercial director, told AVIATION WEEK. "We feel that it can more than hold its own against the big jet during the first few introductory years."

Temporary Advantage

One temporary advantage for the Britannia—as well as the Comet—in Granville's view is the airport facilities which for a few years will create problems for the big turbojets. Another factor is schedule frequencies, which will be greater with the Britannia than with the turbojets during the early stages of their operations, according to Granville.

Economy of operation also is a Britannia attribute, the BOAC official said. He expects the seat-mile cost of operating the Britannia over the Atlantic to be about 10% less than the DC-7C's cost. In its Eastern and African operations, the Britannia 102 has shown the lowest seat-mile cost of

BRITANNIA 312 on ramp at London Airport is one of 18 of the long-range turboprops ordered by British Overseas Airways Corp. Five have been delivered.

any plane BOAC has operated. It replaced Lockheed 749 Constellations and Argonauts on the routes.

Load factors on the 102 routes, according to Granville, have stepped up 3 to 5% since introduction of the Britannias to about 65% average, and they are running about the same percentage over the competition, chiefly 1049 Constellations and DC-7Cs. "We're not running away with all the business," Granville said, "but we're making progress with it."

He expects an average transatlantic load factor of 65% with the Britannia.

The 102s are operated entirely in mixed configuration with 24 first class and 48 tourist seats. Passenger reaction in both classes has been consistently good, Granville said, and flameout incidents with the Proteus 705 engine never affected passenger confidence or load factors. The airline has 15 Britannia 102s in its fleet, will receive a total of 18 of the 312 series.

BOAC's present weekly transatlantic service is a first class flight with 28 de luxe and 24 standard seats, plus 15 berths. Scheduled time is 8 hr, 50 min. eastbound and 12 hr. westbound, but BOAC is consistently beating these conservative schedules and they may be reduced.

The airline plans daily peak season Britannia services this year over its London-New York-San Francisco and London - Montreal - Detroit - Chicago routes. These flights will all be in mixed configuration with 54 economy seats, two and three abreast, 15 two-abreast standard first class seats and 12 de luxe two-abreast seats.

Later on, some 312s will go into London-Johannesburg service, replacing 102s which will be shifted to Australian and Far Eastern runs to build frequencies on those routes.

Light Loads So Far

Loads on the transatlantic service, which departs London on Fridays and New York on Sundays, have been fairly light so far, according to BOAC. The airline has not pushed the Britannia service strongly yet in its advertising.

The turboprop service is presently a very small part of the total transatlantic capacity of the airline. A Proteus engine window display in BOAC's Fifth Avenue office here has been installed, however, and advertising will be increased as frequencies are stepped up.

Delivery delays put BOAC behind in its Britannia program from the standpoint of both schedule frequency and route training. Five of the long-range airplanes had been delivered by the middle of January. The airline has made seven roundtrips over the Atlantic on proving flights and has taken its 312 equipment into several U.S. cities on training missions.

The Britannia, like the Viscount, operates from Idlewild under normal air traffic control handling. Only exception is in taxiing out for takeoff. When there is delay and a line waiting to take off, the turbine pilots are advised as to when they will be able to get off and wait on the ramp until just before that time.

Trans-Canada Plans Added Europe Service

Trans-Canada Airlines will start additional services to two more European countries in April and May, according to a report made in the Canadian Parliament by Transport Minister George Hees.

TCA in April will start service between Canada and Belgium, with a stop at Brussels on the Montreal-Dusseldorf service. Early in May, TCA starts service to Switzerland, stopping at Zurich on its Toronto-Montreal-Paris service.

Hees also said that Canadian Pacific Airlines will make a stop at Edmonton on its polar service between Vancouver and Amsterdam. Until now, passengers to and from Edmonton have made CPA connections at the gold mining camp of Yellowknife in the Northwest Territories.

NOTABLE ACHIEVEMENTS IN WIND TUNNEL TESTING — NO. 3

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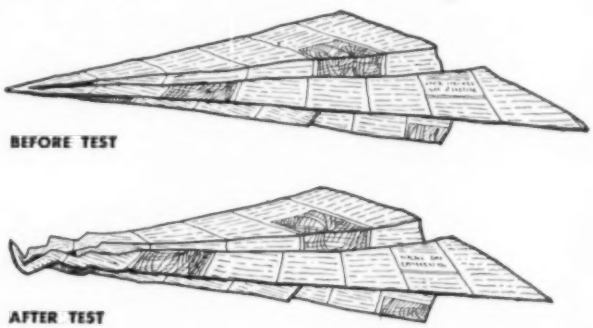

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SHORTLINES

▶ **Air Transport Assn.** reports airline business transactions conducted through the Airlines Clearing House in November showed an 8.19% increase over those for the same month of 1956. Total interline business in November was $62,761,760.24, compared with $58,006,460.91 in November, 1956.

▶ **American Airlines** will pay a dividend of 25 cents per common share in March to holders of record as of Feb. 15. Airline's board of directors also declared a regular quarterly dividend of 87½ cents per share on 3½% cumulative convertible preferred stock payable March 1 to stockholders of record at close of business Feb. 15.

▶ **Hawaiian Airlines** reports it carried 457,785 revenue passengers during 1957, equivalent to almost the entire civilian population of the Territory of Hawaii. Hawaiian ferried the passengers 61,829,000 passenger-miles, a 6.9% increase over 1956. It also flew almost 20 million lb. of air cargo in 1957, a 3% increase over 1956.

▶ **Mohawk Airlines** reports that it carried 31,966 revenue passengers 5,721,914 revenue passenger-miles during December. The figures represent 21.1% and 21.4% increases respectively over December, 1956. Mohawk also carried 76,553 lb. in air mail and 21,432 lb. of first-class mail, 133,566 lb. of express and 165,303 lb. of air freight during the month. Preliminary figures for 1957 indicate that Mohawk flew 420,564 passengers approximately 80 million passenger-miles, an increase of 18.9% and 26.7% respectively over the previous year.

▶ **Trans-Texas Airways** carried 19,487 revenue passengers 4,435,000 passenger-miles during December, the first time the airline's December figure has overshadowed a November figure. December figures were 12.12% and 12.18% respectively above those of November. Trans-Texas' year-end figures show the carrier ferried 243,293 passengers approximately 55,300,000 passenger-miles.

▶ **West Coast Airlines'** new Fairchild F-27 transports to be placed in service in mid-summer will carry stewardesses for the first time in the company's history. West Coast has been using male flight attendants because of frequent stops requiring handling of mail, freight and baggage. The carrier's first stewardess training class will begin in a few weeks with graduation scheduled in March.

AIRLINE OBSERVER

▶ Watch for a compromise move by Congress, placing the rate increase for first-class mail at four cents rather than the five cents urged by the Administration. Congress also will indicate its desire to have the mail moved by air on both trunkline and local service carriers by insisting that all first-class mail be transported by the most expeditious means.

▶ **Airlines fear the recently-adopted Civil Aeronautics Board regulation covering depreciation practices on airframes and engines will have a deterring effect on re-equipment programs. They claim that retirement of piston-engine aircraft is an important factor in the purchase of jet transports, adding that time variances for retirement swing widely among individual airlines. For example, American Airlines will retire its DC-7s in 1961 because the aircraft will lose its competitive power in its markets after that date. Another major carrier feels its DC-7s will compete effectively until 1965 and has chosen that date as a retirement target. Regulation, which became effective Jan. 1, calls for a straight-line method of depreciation and a seven-year life with a 15% residual value. Air Transport Assn. has appealed the ruling in the Circuit Court of Appeals.**

▶ Airline stocks are showing new strength on the New York Stock Exchange and performance since the first of the year has brought about steady advances compared to the virtual standstill that held prices during the latter quarter of 1957 close to the year's lows. Capital and Eastern have registered the biggest gains for 1958 thus far.

▶ **Italy's Zappata A-Z-A four-engine DC-3 replacement is nearing completion and is expected to fly by the end of next month. Plane carries up to 26 passengers, is powered with four British Alvis Leonides 502/5 engines rated at 540 hp. each for takeoffs. Wingspan is 84 ft. Quoted direct operating costs are about 25 cents per ton nautical mile at most economical stage lengths, 375 to 500 nautical miles.**

▶ Local service airline interest in pooling resources for the maintenance and overhaul of the Dart turboprop engine that powers the Fairchild F-27 transport is beginning to wane. Strong possibility now exists that most local service carriers will contract with Capital and Continental airlines to handle engine overhaul functions. Continental is expecting delivery on the first turboprop Viscount this spring, and the first F-27 deliveries will begin shortly afterwards.

▶ **Northwest Airlines air-ground public telephone system installed in the rear of the passenger cabin of a Boeing 377 Stratocruiser has become so popular with passengers that it is in constant use for long-distance calls during flights. Northwest's unit is one of six provided by the American Telephone and Telegraph Co. to check operating efficiency and public reaction to the airborne service. Other units have been installed in private and business planes** **(see page 90).**

▶ Civil Aeronautics Administration has let a contract to Sylvania Electric Products Inc. for the purchase of 31 complete condenser discharge sequence flashing light systems and associated equipment. Thirty of the systems will be installed at U. S. airports but one was procured for shipment to Brazil under an International Cooperation Administration program. Sequence flasher systems are presently in operation at Newark, Cleveland, New York Idlewild Airport, Boston and Los Angeles.

▶ **One direct result of airline economy drives to fight climbing expense levels has been a sudden halt in the expansion of city ticket and sales offices, particularly in off-line cities. Activity in this field declined to a virtual standstill last year after several years of steady growth in the number of street and hotel ticket offices as a competitive tool in drawing passenger traffic.**

▶ American Airlines, Braniff Airways and KLM have contracted with Hardman Tool & Engineering Co. for individual versions of the luxury siesta seats for their Lockheed Electras. Hardman is producing all the lounge configurations on the Electra.

SEA DUTY—Largest helicopter ever operated from an aircraft carrier is the twin-engined Marine Corps HR2S-1 (Sikorsky S-56), shown here landing aboard the carrier *Valley Forge*. Sikorsky HRS and HSS helicopters, seagoing veterans on a variety of Navy and Marine Corps missions, also flew from the carrier during recent fleet maneuvers off Guantanamo Bay, Cuba.

AROUND THE WORLD WITH SIKORSKY HELICOPTERS

MISSILE MOVER—Army tests have demonstrated the ability of the big H-37 (S-56 type) to transport missiles, launchers, and support equipment as well as vehicles and other cargo. Here it unloads an Honest John missile. The H-37 normally carries 26 combat troops or about 3 tons of cargo.

FOR EMERGENCIES—Chance Vought Aircraft will use this Sikorsky S-58 for supporting the company's flight program and for search, rescue, and salvage duties. The S-58 will also be available in the Dallas area for disaster relief and other public services, and will transport high priority passengers and cargo.

SPEEDING POWER LINE CONSTRUCTION—The Southern California Edison Company has erected high-voltage transmission lines more quickly using a Sikorsky S-58 helicopter to carry structural steel and other materials direct to tower sites in rugged terrain. The utility company's lines cross mountainous areas where surface transportation cannot operate efficiently. The big S-58, shown here installing a 50-foot pole, can carry two tons of cargo and move it wherever needed.

HELICOPTER HISTORY

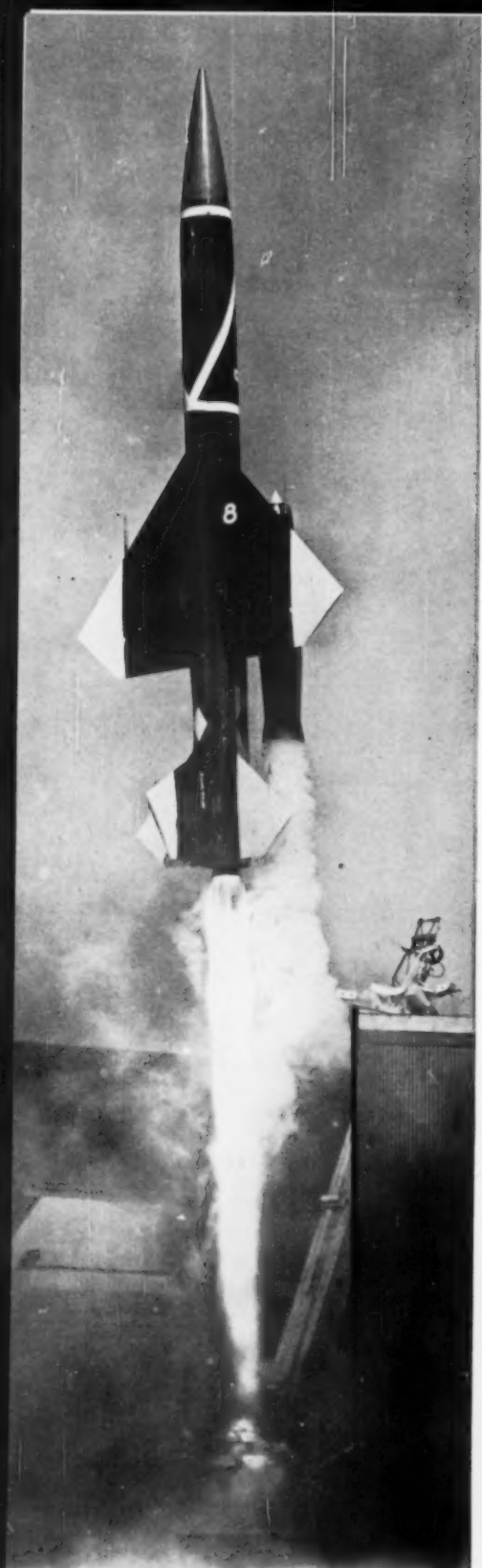
FIRST MAJOR PUBLIC HEALTH PROJECT
In May, 1951, the government of Belgian Congo received the first of three S-51s to be used in aerial spraying to kill disease-spreading insects. Since then helicopters have flown many times over native villages like that shown here as well as over Leopoldville, helping stamp out malaria, sleeping sickness, and other diseases.

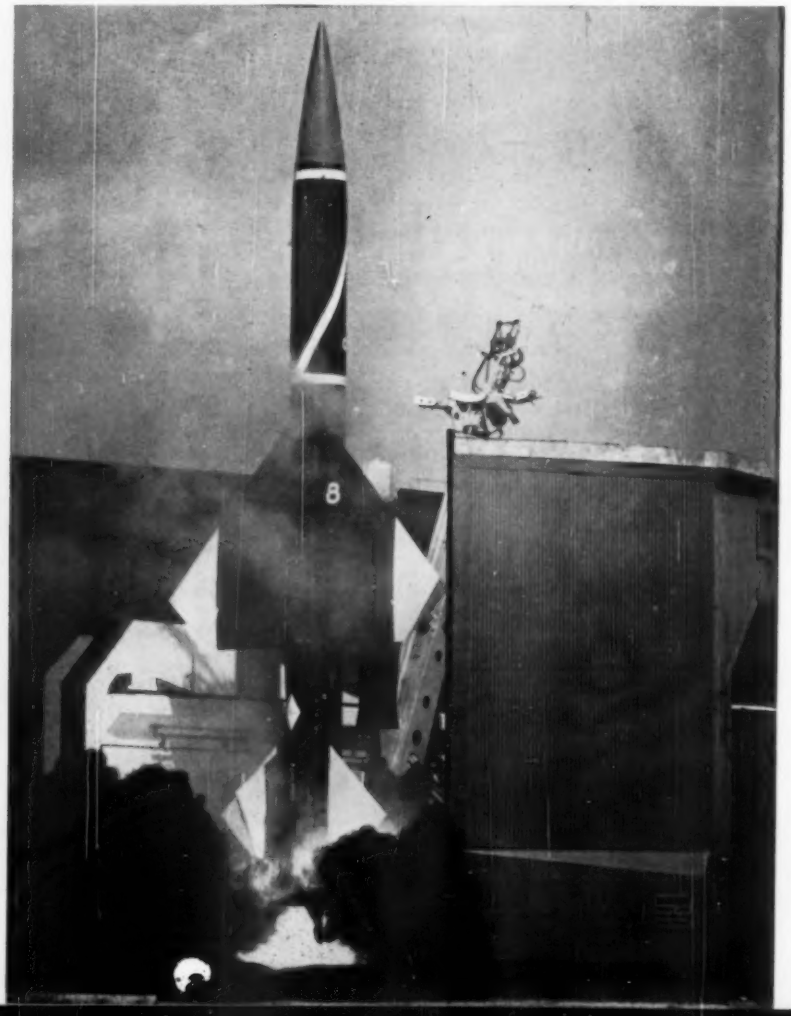
SIKORSKY AIRCRAFT
STRATFORD, CONNECTICUT
One of the Divisions of United Aircraft Corporation

First production Bomarc rolls out, while four more take shape in background.

Air Force Orders 100 Bomarc IM-99s

Boeing will produce approximately 100 Bomarc IM-99 area defense missiles and supporting ground equipment under Air Force production letter contract. Order was second for tactical models of the rocket-ramjet-propelled missile, for which $139 million of Fiscal 1957 funds were authorized. Production under new contract would be financed from Fiscal 1958 funds. Bomarc is 47 ft. long, has 18 ft. wingspan, weighs 15,000 lb. Ceiling is above 60,000 ft., altitude from which an unarmed IM-99 hit a drone B-17 at a distance of more than 100 mi. First of four tactical Bomarc bases will be Dow AFB, Me., McGuire AFB, N. J., Otis AFB, Mass., and Suffolk County AFB, N. Y. About 80% of the work on Bomarc will be subcontracted.





Bomarc IM-99 missile shown (right) at instant of firing, leaves launching shelter propelled (above) by rocket, with ramjets smoking. Missiles can be fired in salvos and directed to individual targets while in flight.

USAF School Simulates Living in Space

By Craig Lewis

San Antonio—As manned flight potential moves higher in the atmosphere and beyond into free space, vital questions arise concerning human reactions to these strikingly new flight environments. Some of the answers to these questions hinge on space medicine research being done here at Randolph AFB and in other U.S. laboratories.

Manned flight capabilities already have reached briefly into the space equivalent areas of the atmosphere, and the firing of Russian satellites into orbit clearly demonstrates the potential for manned flight into free space in the next decade.

To find out as much as possible about the effects of this new environment on human pilots and passengers and to determine what man must do to preserve life in these regions, the Air Force's space medicine experts are currently conducting a program of basic research in four fields here at the School of Aviation Medicine:

- **Space cabin simulator** in which subjects are sealed for various time periods shows human reactions to life in an environment sealed off from world, operates as self-contained unit.
- **Psychological testing** done on subjects in space cabin simulator shows degrees of vigilance, discrimination, judgment and other factors during extended periods of isolation in simulated space environment.
- **Flight program** producing brief periods of weightlessness provides knowledge of this new condition with which space travelers will have to cope.
- **Experiments with photosynthesis** point to possibility of using algae as means of absorbing toxic carbon dioxide and producing oxygen in vehicle making extended flights in space.

Free Space Approached

Man already has made brief forays into areas of the atmosphere which are partially equivalent to free space in vehicles such as the Bell X-2 rocket airplane (AW Dec. 23, p. 65) and the balloon which carried Maj. David Simons to 102,000 ft. (AW Aug. 26, p. 33). Next major step is the North American X-15 which will fly into an area where the atmosphere is so thin that it is equivalent to free space, for all practical purposes.

The X-15 is the next step to a manned satellite, and Dr. Hubertus Strughold, adviser on research in the space medicine program here, describes the current position of flight in the upper regions as in a "kind of amphibian stage." It is in a transition between the familiar atmospheric flight and the space equivalent and free space environments of satellite flight and, later, lunar and interplanetary flight in free space.

Dr. Strughold points out that the hardware to be used for manned satellite flight is the concern of the engineer. But the engineer needs medical advice to determine what kind of vehicle a man can live and work in, and Dr. Strughold says that space medicine is prepared right now to give engineers the necessary advice and human requirements for space travel.

Ground Study

Researchers here and elsewhere are studying the effects of such things as cosmic ray bombardments, the darkness of space, weightlessness and other factors which can be studied on or near the Earth.

Dr. Strughold feels that all elements of the problem that can be researched on the ground are now under study, although he points out that not all studies are complete. Some factors, such as the effect of extended periods of weightlessness, can only be studied in space.

An important element in the design of a manned satellite is the fact that the man must return to Earth. Thus, the satellite must not only solve the problem of keeping its passenger alive and functioning, but it must provide means of re-entering the atmosphere and returning the passenger safely to the ground to make the medical aspects of the experiment worthwhile.

A kind of prototype for a manned satellite exists now at Randolph AFB in the form of a space cabin simulator. It looks like a small furnace covered with a maze of plumbing and bears no similarity to actual satellite hardware. But the environment produced inside the simulator is the same kind of environment the satellite or space ship will have to provide its passenger.

This simulator is a hermetically sealed cabin that supplies its own oxygen, disposes of waste products and supplies water. It's not a new idea, since sealed cabins began with the work of Auguste Piccard in 1931, and balloon gondolas have used the principle down to Maj. Simons' recent flight. But this cabin permits detailed studies of the effect of its environment on its passenger.

VOLUNTEER subject A/2C Fred W. Childress sits in space cabin simulator at USAF School of Aviation Medicine to demonstrate cramped quarters subjects experience in studies of space flight conditions.

The cabin provides about 100 cu. ft. of space. It is not high enough for a man of normal height to stand up in, and the possibilities for exercise are very limited. The subject sits in a regular aircraft seat and faces a panel of lights, switches and displays which are used to test his psychological reactions to confinement.

Drinking Water

The cabin is capable of recycling water to provide drinking water. Moisture is taken from the air and condensed, and urine can be distilled for drinking purposes. Technicians are working on a means of incinerating other human waste. Subject will be provided with normal in-flight rations, and the cabin is fitted with a food warmer.

Oxygen is supplied from external tanks, and blowers circulate cabin air through baralyme carbon dioxide absorbent. An activated charcoal absorption system is used to handle the odor problem, although it is relatively minor.

Temperature and humidity levels are controlled through an air conditioner, a heater and a vaporizer. This equipment is juggled in an effort to find the ideal combination of temperature and

Northrop T-38
Super Sonic Jet Trainer

Convair 880
Jet Airliner

Lockheed T-33
Jet Trainer

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Northrop Snark
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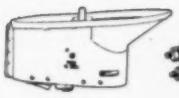
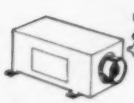


Rocket Mounts

Rocket Switches

Limit Switches



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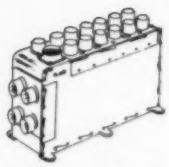
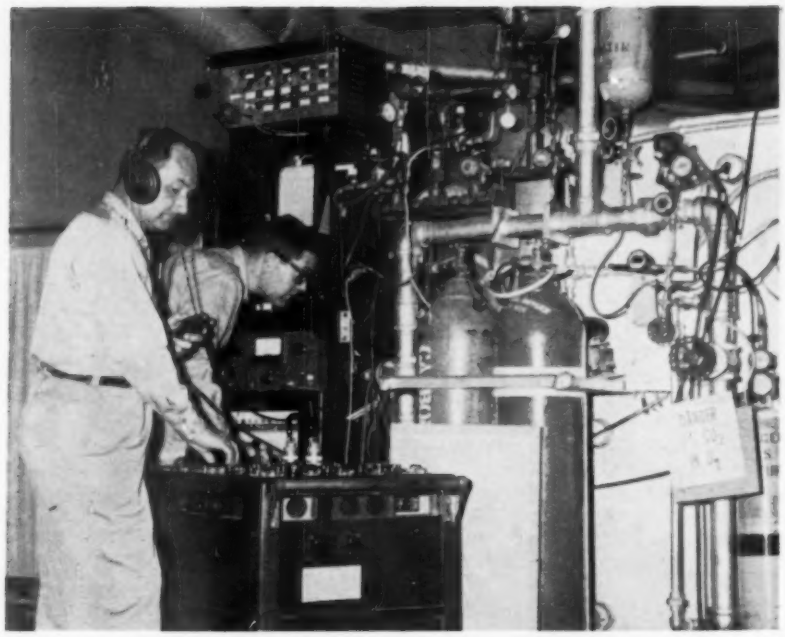


Miniaturized Electrical Substation for ground-power check-off of **GUIDED MISSILES**



LT. COL. George R. Steinkamp (left) and Capt. Julian Ward monitor instrumentation while experiment is conducted in the space cabin simulator.

humidity and to determine the ranges within which a man can work efficiently and live comfortably.

Tolerable Altitude Sought

Medical men would like to have the space traveler live in an atmosphere similar to sea level conditions, but the engineers balk at this and want to lower the pressure differential to relieve structural problems. So experiments in the simulator are attempting to determine the highest equivalent altitude man can tolerate. It is probably somewhere between 18,000 and 25,000 ft.

During these experiments, the subject doesn't wear an oxygen mask, although one is provided for emergencies.

A number of short flights have been made in the simulator, but the most successful so far was a 24 hr. experiment made at an equivalent altitude of 18,000 ft. Various factors are monitored in these flights, including the subject's heart action and respiratory rate. Temperature is recorded at five different points with thermocouples.

Emergency Precautions

A medical officer and a technician are on duty throughout the run, and the simulator has an alarm system for use in emergencies. There is also an intercom system for emergency use or in case a subject should want to leave before the experiment is complete.

A new, larger space cabin simulator is planned to accommodate two men. It will be a modular design which will be expandable, and researchers are hoping it will be ready when the School of Aviation Medicine moves to new quarters at Brookes AFB about a year from now.

Experiments will continue with various altitude levels to find the best compromise. As cabin altitude is increased, oxygen pressure is kept at ground level so that as the cabin atmosphere goes up, the proportion of oxygen increases.

The simulator has been moved to new quarters at Randolph AFB, and some of its equipment now is being overhauled. When it is back in working order, the next big step will be a one-week flight planned for February or March.

Psychological Problems

According to Capt. Julian Ward, one of the medical officers working with the simulator, these longer flights probably will produce few physiological problems. He feels the psychological problems of a subject completely isolated for a week are liable to be somewhat more serious.

In these experiments, a subject is taken out of his normal working condition and put in an abnormal, complex position. The psychologists want to find out how this change affects a man's normal proficiency curves.

A key tool in this work is a testing console which has been in use for about two months. It presents a battery of lights, displays, buttons and switches to the subject in the cabin. Problems can be set up on the console to test effects of the environment on the subject as the flight progresses.

Tests for vigilance and alertness will

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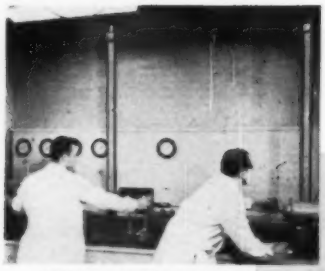

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require response to indicators on the console and will require recognition of error. Response times can be measured to determine the degree of vigilance.

Subject's discriminatory powers are measured by requiring him to choose the proper solution to an emergency situation. For instance, he will have to react to different combinations of warning lights by flipping the proper switch.

Judgment is tested by comparing displays. The console has a static display and a dynamic radar display. The pattern on the dynamic display is in motion, and at one point will match the static display pattern. The subject must judge when the two match and signal with a switch.

Testers will use a random distribution of events totaling about 60 an hour, some of them simultaneous.

Problem Solving

Problem solving proficiency is analyzed by measuring how quickly and accurately the subject responds, say, to a problem of extinguishing lights with a set of switches. He has to figure out a logical sequence of actions. The rules remain constant from problem to problem, but the relations of switch to light change.

These tests will indicate how long-term confinement and isolation will affect proficiency in these four areas. They also will show how the subject's proficiency reacts to changes in the gaseous environment. Mixtures of carbon dioxide and oxygen can be adjusted for work in this area.

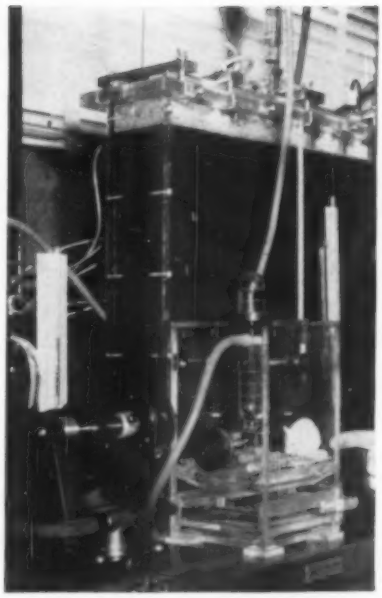
Another factor which interests psychologists is the effect of nutrition over an extended period. Fatigue studies have shown that some people differ in food preferences under the effects of fatigue, and this factor is important in determining the best diet for the subject in terms of preference and maintenance of efficiency.

Fatigue Factor

Fatigue is also a factor in setting the day-night cycle in this artificial environment. Research will have to determine how the work and rest period should be distributed to maintain proficiency. Previous experiments have determined that the length of the daily cycle can be changed, but now the task is to find out how much it can be shortened or lengthened.

On a hypothetical six-day flight with a three man crew, cycling would have to be arranged so there would be a highly reliable man available at all times. Work-rest cycles would have to provide a uniform high level of proficiency over six 24-hr. periods.

Tests of the effects of fatigue on pro-



CARBON DIOXIDE exhaled by mouse in sealed chamber is exhausted from the chamber and circulated through algae-filled tank in background. In this tank, the algae is exposed to fluorescent light and converts the carbon dioxide into oxygen through the process of photosynthesis. Oxygen is then cycled into the chamber, keeping the mouse alive.

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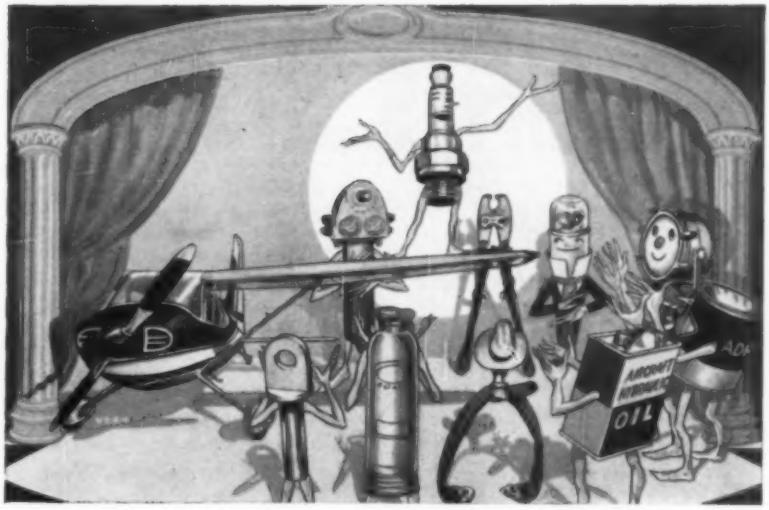

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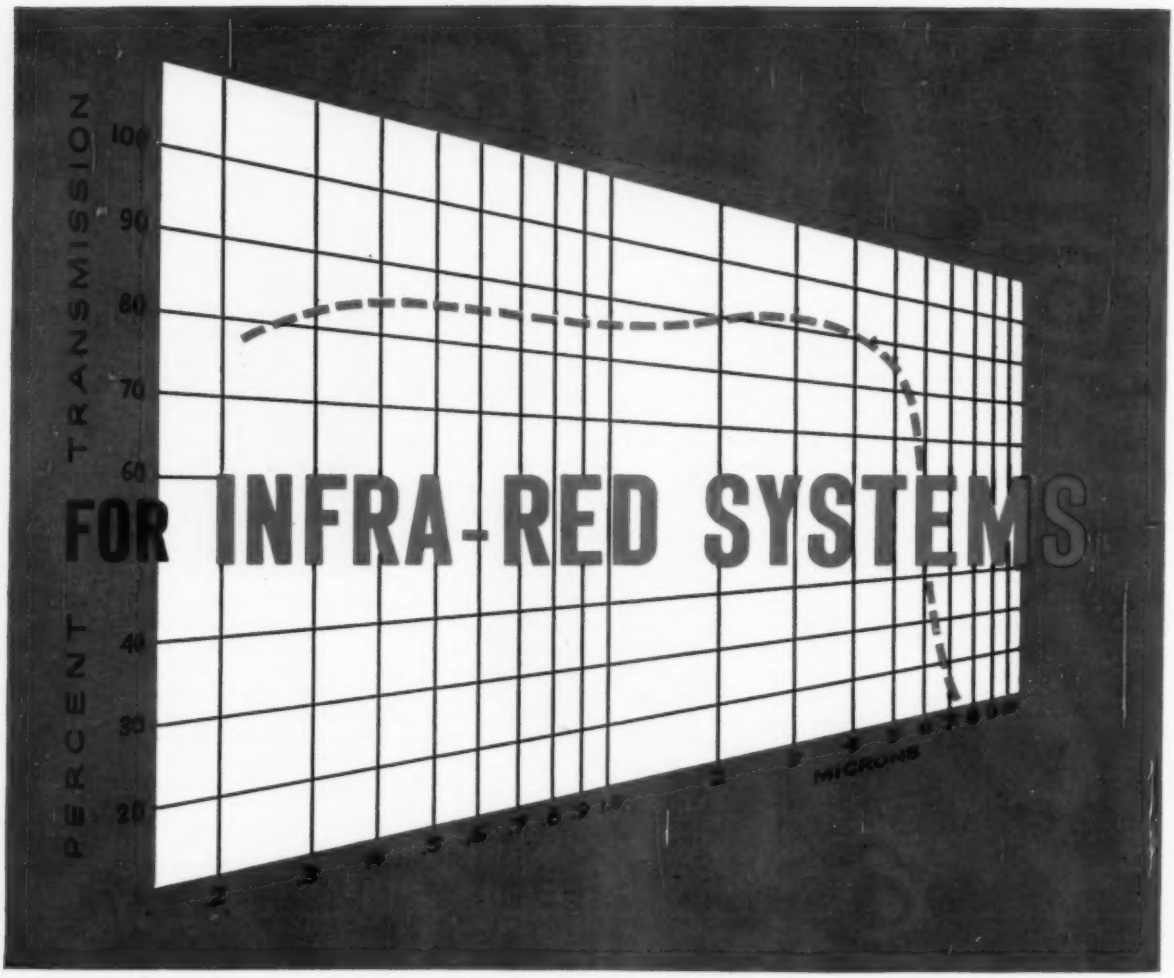

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MAJ. HERBERT D. Stallings, Jr. (left), and Dr. Siegfried J. Gerathewohl stand by Lockheed F-94C which is equipped with recorders and cameras for studying weightlessness.

ficiency outside the simulator have indicated cycles of maximum efficiency over long periods and illustrated the effectiveness of countermeasures such as drugs, human engineering, motivation techniques and scheduling.

Optimum Cycles Vary

It has been found that optimum cycles depend on the tasks involved and are highly individual. It has also been determined that there are work-rest relationships which prevent fatigue and deterioration of proficiency.

Once the best work-rest cycles are determined, it probably will be necessary to change and relate the cycles of the crew members before takeoff so they will be adjusted to the new regime. Drugs may be helpful here to induce sleep and wakefulness in regulating the cycles.

Dr. George T. Hauty, who is in charge of psychological testing, points out that initial space flight programs probably will have the advantage of using highly motivated, skilled people such as the group flying at Edwards AFB.

Still, a certain amount of screening would be necessary, and volunteers would be tested under simulated space flight conditions to test their reactions to such phenomena as weightlessness.

Weightlessness Effects

This question of the effect of weightlessness on men flying through space is one of the major unknowns in space flight, but work done here in zero gravity experiments has developed a new, if somewhat limited, body of knowledge on this condition.

Weightlessness is now experienced for relatively brief periods with some of the aircraft now flown in the atmosphere when they are in a zero gravity condition. The period of weightlessness will increase as speeds graduate into the X-15 category. A manned satellite will be in a prolonged state of weightlessness since one characteristic of orbital flight is the fact that centrifugal forces balance the Earth's gravitational pull.

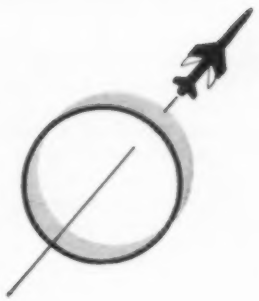
The true test of human reaction to weightlessness will not come until a man is exposed to an extended period of it, but some valuable data on the effects of short periods of weightlessness have been gathered here in a flight program operating since 1955.

Weightlessness Induced

Space medicine researchers have been able to induce weightlessness for periods of up to 43 sec., and findings so far indicate that this condition presents no bar to manned flight in space.

Brief periods of weightlessness have been induced in a flight program employing Lockheed's T-33 and F-94C aircraft. Since weightlessness is a function of speed and trajectory and is produced by the equilibrium of centrifugal force and gravity, this zero gravity state is induced by flying the jet aircraft in a Keplerian trajectory. The condition occurs when the aircraft is describing a parabolic arc.

After some experimentation with various altitudes and maneuvers, researchers decided that 20,000 ft. was the proper altitude to use in the experiments. A T-33 was the first aircraft assigned to the program, and it was used for about eight months. A wide variety of subjects were carried in the rear seat



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Missiles men have not been fiddling while Sputniks soar. The armed services have done a commendable job considering the lack of cohesive leadership. We hope sincerely that, under the new program, our ballistics missiles can and will get off the ground to perform their appointed tasks.

We forecast that with more efficient propellants; with lighter, stronger, more heat resistant materials; but chiefly with new IDEAS – which may have little or no resemblance to conventional thinking – we have a better than even chance to move into a more favorable position in the missiles marathon.

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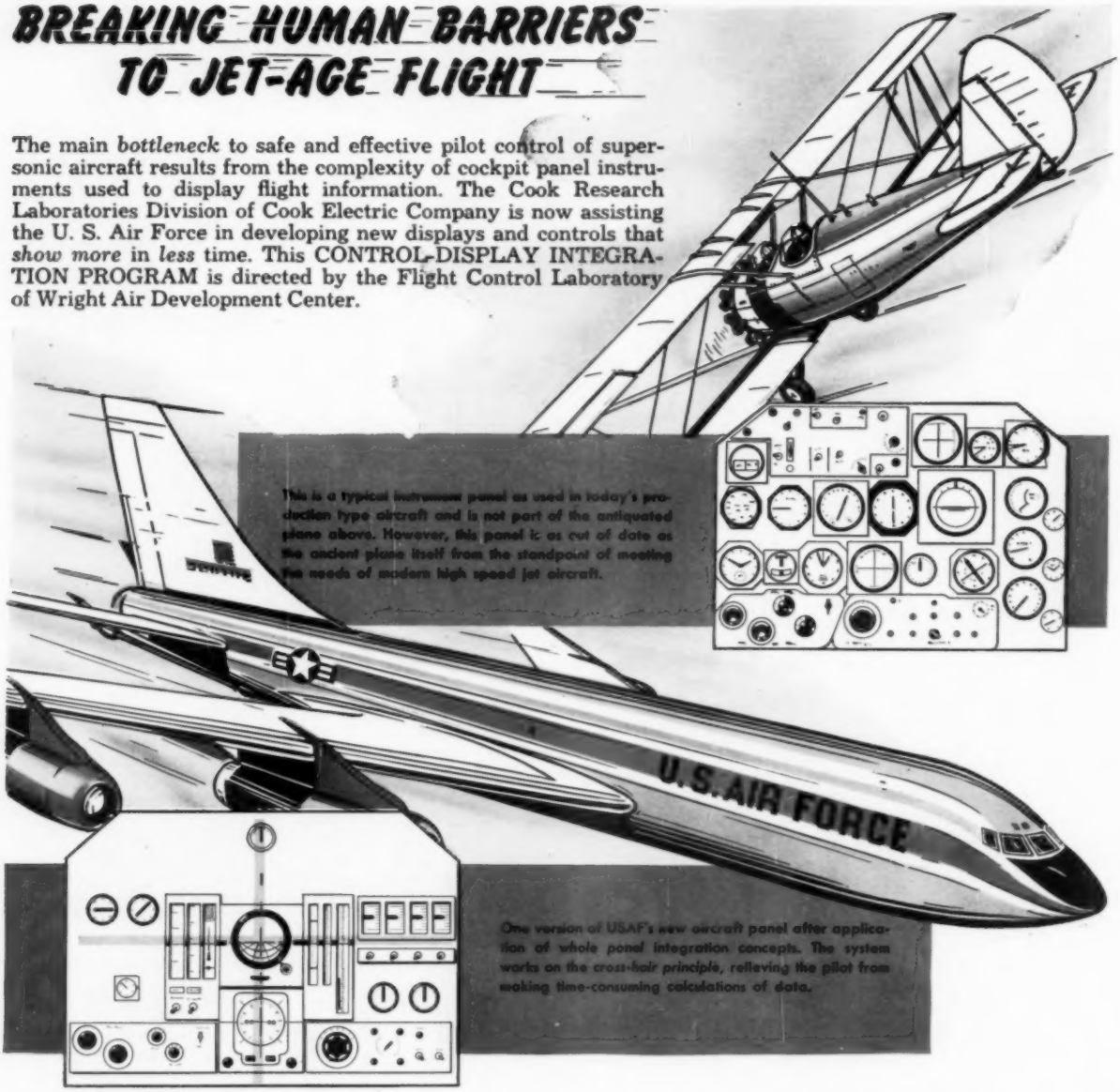
BREAKING HUMAN BARRIERS TO JET-AGE FLIGHT

The main *bottleneck* to safe and effective pilot control of supersonic aircraft results from the complexity of cockpit panel instruments used to display flight information. The Cook Research Laboratories Division of Cook Electric Company is now assisting the U. S. Air Force in developing new displays and controls that *show more* in *less* time. This CONTROL-DISPLAY INTEGRATION PROGRAM is directed by the Flight Control Laboratory of Wright Air Development Center.



This is a typical instrument panel as used in today's production type aircraft and is not part of the antiquated plane above. However, this panel is as out of date as the ancient plane itself from the standpoint of meeting the needs of modern high speed jet aircraft.

One version of USAF's new aircraft panel after application of whole panel integration concepts. The system works on the cross-hair principle, relieving the pilot from making time-consuming calculations of data.

The objective of the *whole panel* program is to eliminate as much as 30% of the maze of instruments and dials that a pilot must scan, and provide more information in an easier to use form. This new panel concept has resulted in a simplified design using the *cross-hair principle*. In this case, however, the vertical and horizontal cross-hairs are not fixed but are made up of many small segments by means of moving tapes.

In normal operation the cross-hairs appear intact. Any deviation of the segments, however small, can readily be seen by the pilot who then knows instantly that a correction is necessary. The break in the line tells him what to do to get the segment back in line. All this can be done instantly without having to read, integrate, or perform conversions of flight data as now required.

Cook Research Laboratories take pride in being able to participate in the all important program of increasing the safety and effectiveness of modern aircraft both for general flight and mission accomplishment.

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to test their reactions to the zero gravity state.

The zero gravity flight in the T-33 began at 20,000 ft. A sharp dive was started with 96% engine rpm., and as IAS (Indicated Air Speed) built up to 350 kt., the aircraft usually reached 17,500 ft. At this point, a 3G pullout was made and the aircraft was put into a climb of about 60 deg. When IAS dropped to 300 kt., the pushover was started. The T-33 reached the top of the parabola at about 180 kt. and somewhere between 20,000 and 20,500 ft. Pushover was continued until the aircraft reached 350 kt. At a dive angle of about 75 deg. a pullout was started to avoid passing the T-33 Mach limit, and usually this pullout was used to start another parabola.

With this technique, periods of virtual weightlessness lasted 25 to 28 sec. Troubles developed with the T-33 fuel system when fuel in the main tank tended to vaporize during subgravity conditions, preventing the fuel pump from delivering enough fuel to maintain engine rpm. Complete loss of oil pressure also occurred, although this was not serious because the J33 engine can run without lubrication for extended periods.

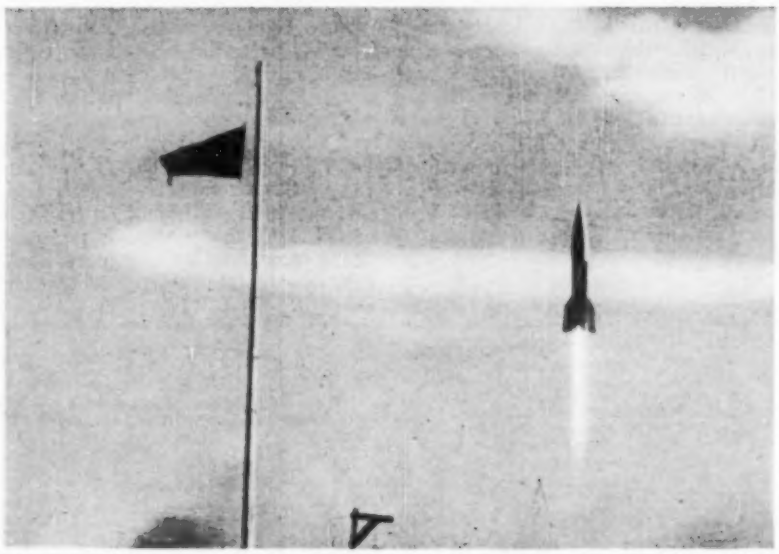
In order to extend the zero gravity period, a faster aircraft was needed, and USAF assigned an F-94C to the program in May, 1956. Various patterns were tried with this new aircraft, and again the decision was made to fly the trajectories in the area of 20,000 ft.

From about 18,000 ft., the F-94C is dived at 100% engine rpm. until IAS reaches 425 kt., then a 1.5G pullout brings the airplane into a climb of 65 to 70 deg. The parabolic flight in the pushover produces weightlessness for periods up to 40 sec. Using its afterburner, the F-94C produced the longest period recorded—43 sec.

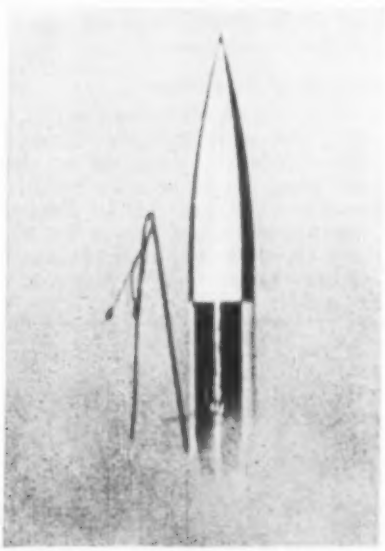
Aircraft Modifications

The aircraft used in the program are standard types, modified only to the extent that recorders and cameras are used to record subjects' reactions. In

Soviet Film Illustrates Preparation for Satellite Launchings



LAUNCHING sequence of rocket appeared in Soviet film, "First Soviet Man-Made Satellites." Launching, apparently of German V-2, was one of first conducted in program.



MISSILE, identical to one at left, is pictured close-up at firing moment.

LAIKA (above) is strapped in special harness prior to being placed in Sputnik II. At right, dog is in compartment shortly before launch.

flight, the standard G-meter is used, but an auxiliary indicator of G-forces in three axes has been installed in the test airplane. It is a golf ball on a string in the pilot's windshield.

In the weightless state, the ball will float free and will move to indicate aircraft acceleration in any of the three space axes.

To stretch the period of weightlessness even further, the department is expecting delivery of a Century-series aircraft early this year. It will probably be a trainer version of the F-100. With this faster equipment, weightlessness states up to a minute and a quarter in duration can be produced.

Maj. Herbert D. Stallings, Jr., has been the pilot through this flight test program. His practice has been to fly the aircraft completely through the trajectory, never using the autopilot. Stallings feels that the pilot can give the most sensitive direction to the aircraft during the zero gravity cycle.

Recording Equipment

Movies are taken of some subjects, and a tape recorder in the intercom system records all conversation. An oscillograph also has been developed to record such physical reactions as heart action and respiration, and the simultaneous aircraft states. This 14-channel system is hooked to three accelerometers to show the relation of the aircraft to zero gravity.

A T-33 chase plane is used for the flight experiments. It serves as a safety factor because of the traffic congestion in the area and the fact that the experimental aircraft is on instruments. It carries a flight surgeon who is in contact with the subject and hears his reactions. The flight surgeon can call off the experiment if the subject appears to be sick.

Subjects chosen for the flights represent a wide variety of physical and professional types ranging from non-flyers to experienced jet pilots. Some attempt is made to use flight surgeons, medical technicians and others who can recognize and relate their experiences more precisely.

Depending on the weather and maintenance status of the aircraft, experimental flights are made five days a week, and usually two to three missions are flown each day. Stallings has accumulated something in the neighborhood of 35 hr. of weightlessness in small increments.

Doctors are studying the physiological aspects of weightlessness, such as circulation, muscle action and other factors. They also have established some groundwork on eating and drinking problems.

It appears that eating in zero gravity will be no problem as long as food is chewed well. If the food is bolted, it may stick going down unless the tract is quite moist.

Drinking Problem

Drinking is more of a problem. It is nearly possible to drown in a glass of water in the weightless state since the water is uncontrollable and can float up the spaceman's nose. Straws are not the answer, but apparently the problem can be solved by using squeeze bottles similar to those commonly used to dispense catsup. Once the water is in the mouth, the muscular system can get it to the stomach.

Another key question involves the effect of weightlessness on sleep. This is a problem in setting work-cycles, but apparently the answer will have to wait for an extended flight in space.

Weightlessness experiments have developed varying reactions. Some subjects have a feeling of euphoria, relief and relaxation. Others don't enjoy it so much, and a number of them have developed motion sickness.

Motion Sickness

Although the number of subjects developing motion sickness is relatively small—25 to 30%—this development would seem to imply that future space fliers may have to be screened to deter-

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mine their tolerance for weightlessness, according to Dr. Siegfried J. Gerathewohl, the man running the zero gravity experiments.

Dr. Gerathewohl points out that only about half the subjects developing motion sickness are probably naturally sensitive to weightlessness. Some subjects who are sick at the outset of the flights build up a resistance to the sickness.

Thus, results of experiments so far indicate that possibly only 10% or so of potential space travelers will be barred by sensitivity to the weightless state.

Sickness Cause Unknown

Since symptoms of sickness caused by weightlessness appear in 40 sec. or less, the trouble is somewhat different from sea sickness, which takes 15 to 20 min. to develop. It hasn't been determined whether it is the change to zero gravity or the state of weightlessness itself which produces sickness. With sea sickness, it is the change from acceleration to deceleration that does it.

Dramamine has been used widely as a remedy for motion sickness, and some subjects in the experiments said they were helped by taking the drug. Others were not. No extensive testing of the effects of drugs has been done.

Mild muscular coordination is necessary to adjust to weightlessness, but it is fairly easy to cure such things as overreaching. Effects of the state on eye-hand coordination were tested by having subjects strike a target with a stylus during the zero gravity condition. There was a mild disturbance of accuracy, but subjects quickly adjusted to it.

Probable Sickness Causes

Dr. Gerathewohl feels that there are probably both psychological and physiological roots to the motion sickness induced by weightlessness. Sensing organs perceive physical changes, and possibly apprehension and insecurity also have their effect. To curb these latter effects, subjects are run through two familiarization flights before they go through the zero gravity experiment.

Prospects of long periods of weightlessness having unforeseen effects are small, according to Dr. Gerathewohl. He feels that the initial period where adaption occurs is the most critical and that if the space flier tolerates weightlessness at first, he probably will be all right on a long flight. Conversely, those who don't adapt well at first may never develop a tolerance for weightlessness.

Dr. Gerathewohl concludes that there should be no reluctance to send people into the weightless state for longer periods of time. He said that he wouldn't mind taking a flight for say, two hours himself, "if I knew the craft was safe," especially since the pilot could move the aircraft to restore weight if he got in trouble.

For the shorter trips into the upper atmosphere and into free space, vehicles will be able to carry their own supplies of oxygen and carbon dioxide absorbent. But when space travel starts lasting one or two months, new methods will have to be found to maintain a habitable atmosphere in the space cabin.

An answer to this problem may lie in the experiments with photosynthesis being done in the Space Medicine Department here.

Photosynthesis Studied

Researchers are wondering whether it is possible to use photosynthesis for a gas exchange system. This would use plant processes to reverse the human cycle of absorbing oxygen and producing carbon dioxide.

Through photosynthesis, plants exposed to light absorb carbon dioxide in their cell matter. Hydrogen in water is used to reduce carbon dioxide to a carbohydrate, releasing oxygen from the water. The exchange produces approximately one molecule of

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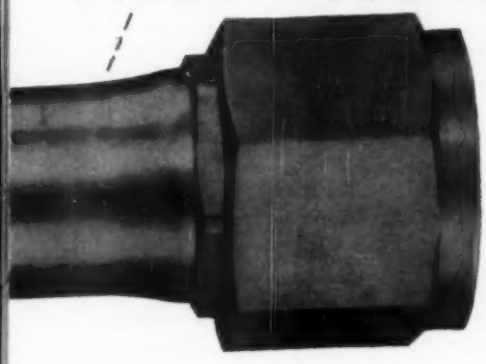

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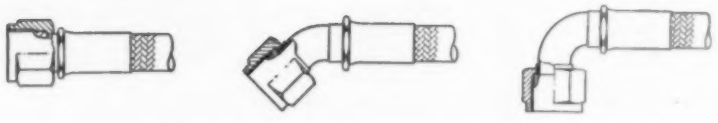

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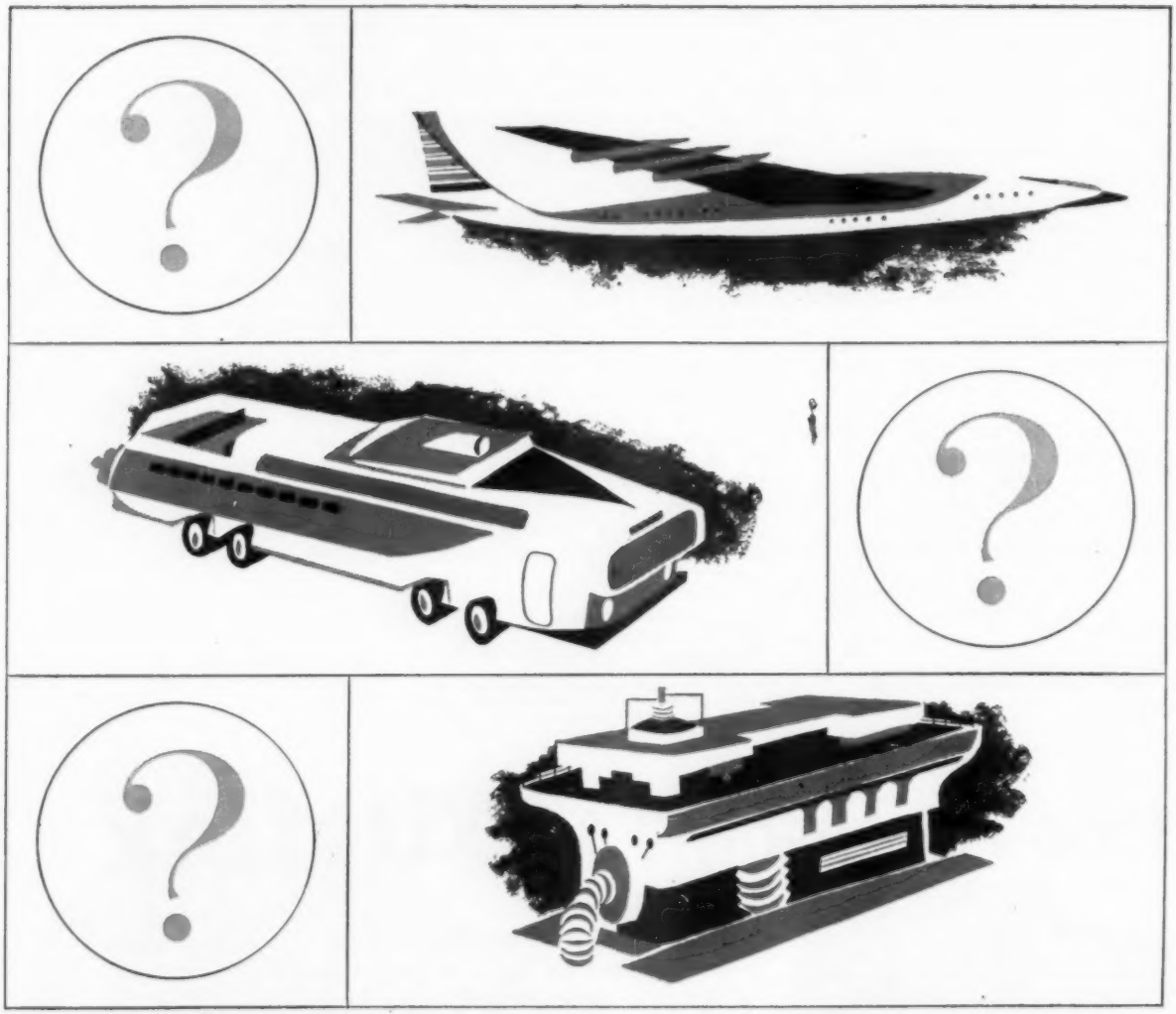

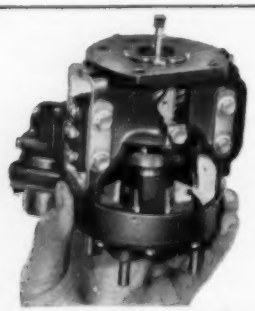

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oxygen for each molecule of carbon dioxide used.

A closed system using the principle of photosynthesis currently is operating here with two mice serving as subjects. The mice are in a sealed chamber from which carbon dioxide is removed and cycled through the system, and oxygen is returned for the mice to breathe. The air is pumped through a bacterial filter when it comes out of the chamber, and it is dehumidified before it goes back to the mice.

Algae in Suspension

Heart of the system is a large tank filled with algae in suspension. The highest rate of photosynthesis is found in microscopic algae, according to Capt. Robert D. Gafford, and a type of blue-green algae is used. This type has a high surface-to-volume ratio and a relatively high optimum temperature for growth. This leads to fewer cooling problems—since high temperature inhibits the growth of bacteria.

The tank holds 20 liters, which is more than the computed amount required for two mice, but the system doesn't get full capacity from the algae because of incomplete illumination. Six ordinary white light fluorescent lamps are extended down into the tank in Plexiglas tubes. The algae now gets 90 w. plus ambient lights, but this will be increased to 120 w.

The algae is fed a liquid nutrient, and some of it must be disposed of because it grows. There is a possibility that human wastes can be processed for use in place of the liquid nutrient, and it is also possible that the algae could be used as food for a space crew.

Thus the experiment holds the possibility of a system that would absorb carbon dioxide and other human waste products, nourish itself on them, produce oxygen and supply food. Present hardware is not practical for space flight, of course, but experiments are proving that photosynthesis can at least be used for a gas exchange system.

Longest period the closed system has run is four days with one mouse, and two mice have lived in the system for three days. The runs were closed down for mechanical reasons, not because the device failed to provide oxygen for the mice to breathe.

British Ready to Test Engine for First IRBM

Initial test of the Rolls-Royce rocket engine intended for Britain's first intermediate range ballistic missile is expected by the end of this month at the Ministry of Supply's Missile test base in Aberporth, Wales. Engine is built under license from North American Aviation and modified for missile design by de Havilland Propellers.

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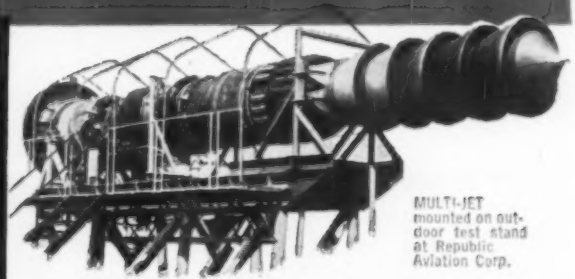

MULTI-JET mounted on outdoor test stand at Republic Aviation Corp.

IAC presents with pride the new MULTI-JET noise suppressor designed to meet diversified applications in the suppression of jet engine noise. Its extreme light weight (less than 400 lbs.) makes it ideal for field run-up operations on nacelle mounted jet engines such as those on military bombers and the forthcoming jet commercial air liners.

A Brochure describing the MULTI-JET silencer and performance data is available upon request.

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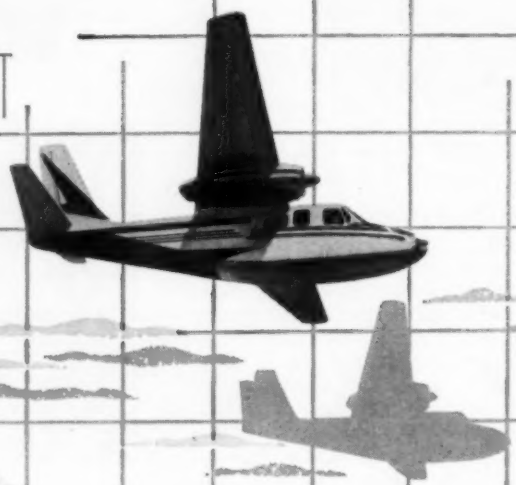

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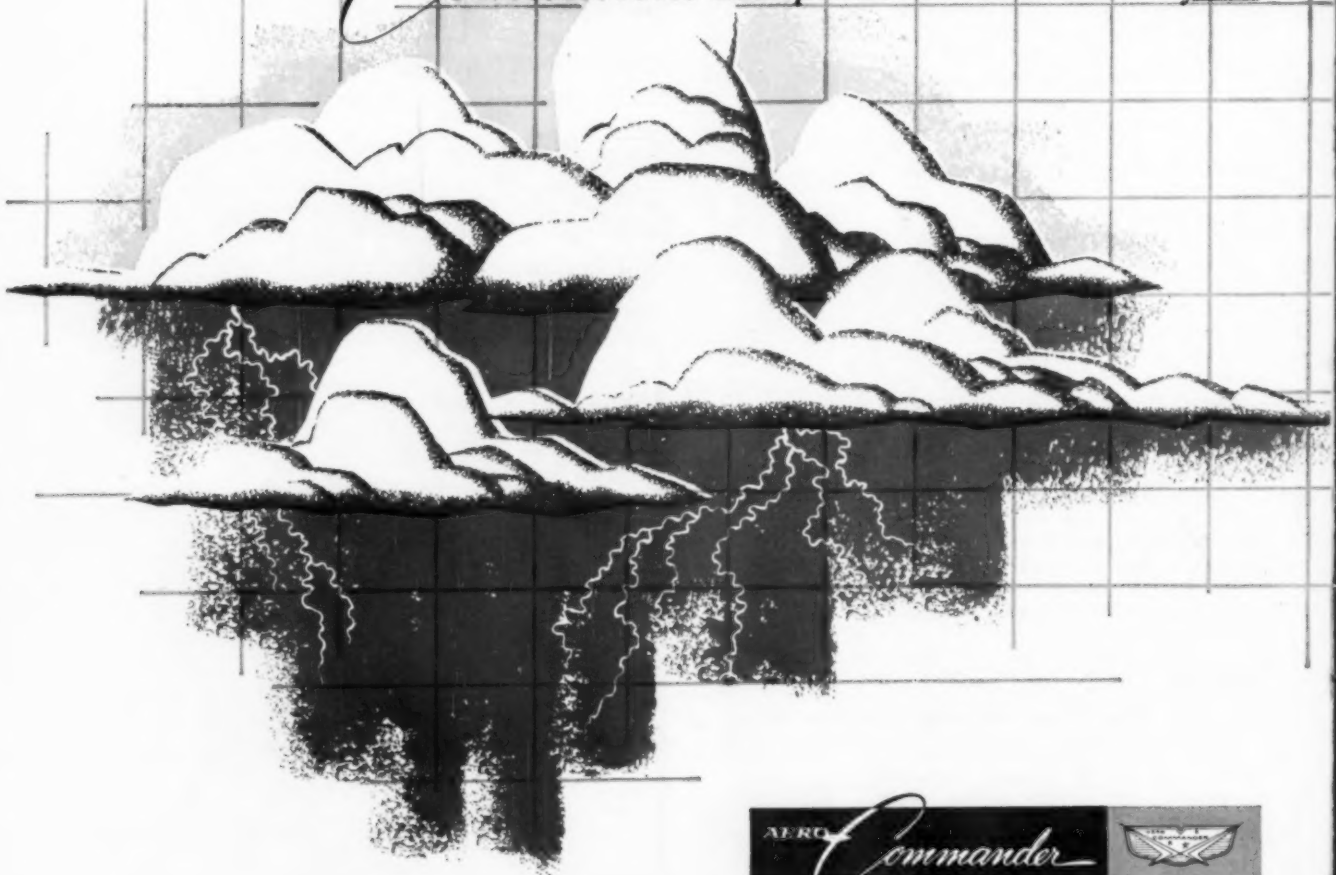

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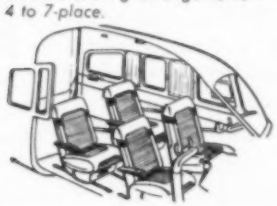

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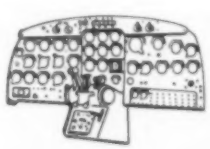

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Missile Firm Closes For Lack of Contracts

Detroit—American Motors is closing its Special Products Division as an "uneconomical" operation.

"We hired a nucleus of competent missile people and tried for three years to obtain a contract worthy of the name," President George Romney said. "We contacted every known procurement agency. We had the excellent plant and production facilities of the Hudson Motor Car Co. to offer. It is my firm conviction that we were bypassed because of an unfounded lack of confidence in our stability as an organization."

Only defense contract that American Motors is still actively pursuing involves the "Mighty Mite," a jeep-like miniature vehicle designed for use by paratroops. Prototypes are currently being tested by the Marine Corps.

Rocketdyne Building Engine Service Unit

Rocketdyne Division of North American Aviation has broken ground for its service center in Canoga Park, Calif.

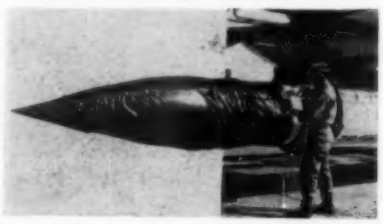
Facility will house division's service unit under direction of James Broadston, will have 132,000 sq. ft. of office and assembly area, will cost $1¼ million. Some 1,000 persons will work at facility which will support Atlas, Thor and Jupiter engine programs.

Center will have three-part organization, factory-to-field spare parts group, field engineers and overhaul plant. Center will have new operating basis for support of rocket engine programs (AW Nov. 25, p. 86), emphasizing speed in overhaul and modification according to customer specifications. Completion is scheduled for fall of this year. Center is being built with company funds.

Army Evaluates Cover For Corporal Missile

Plastic missile cover developed for the Army for the Corporal missile has completed over 14 months' field testing at White Sands Proving Grounds.

Called the 103 cover, and made from L-10-T cover material, it is said to be lighter in weight, faster and easier to put on than any cover yet developed. The three section cover weighs less than 50 lb. and can be put on the missile while it is on the erector in either the ground level or vertical position. Removable with one main zipper, the cover can be removed from the missile while it is in firing position in less than 45 sec. Built-in doors over access hatches aid in field adjustments and maintenance.



Aircraft and field electronic equipment covers have also been developed from L-10-T material. Unit is manufactured by Airconductors, Gardena, Calif.

Missile Devices Firm Extending Operations

Micronics Division of Elgin National Watch Co. will extend operations of its Chatsworth, Calif., research and development plant to include custom production as well as design of guided missile and aircraft devices. The plant specializes in high precision components for the military. Lincoln, Neb., plant, now to be abandoned, formerly handled production of Chatsworth design. Micronics Division work will also be done at the company's new plant being built near Palatine, Ill.

THE 479 DAY TEST: 510 it's a RECORD!

We knew they were good . . . the trade knew they were good . . . welding engineers knew they were good. But nobody was prepared to forecast that the new Miller line of GOLD STAR welders would erect a startling milestone in welding history . . . in welder performance!

In August, 1956, Miller began production on a new completely sealed semi-metallic rectifier. The date proved to be significant in welding circles. For 510 days later NOT A SINGLE FAILURE HAD BEEN REPORTED FROM THE FIELD!

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a. The best welding current ever produced,
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The 510 day test was made on thousands of Miller GOLD STAR welders working under every conceivable condition—indoors—outdoors—in hundreds of industries.

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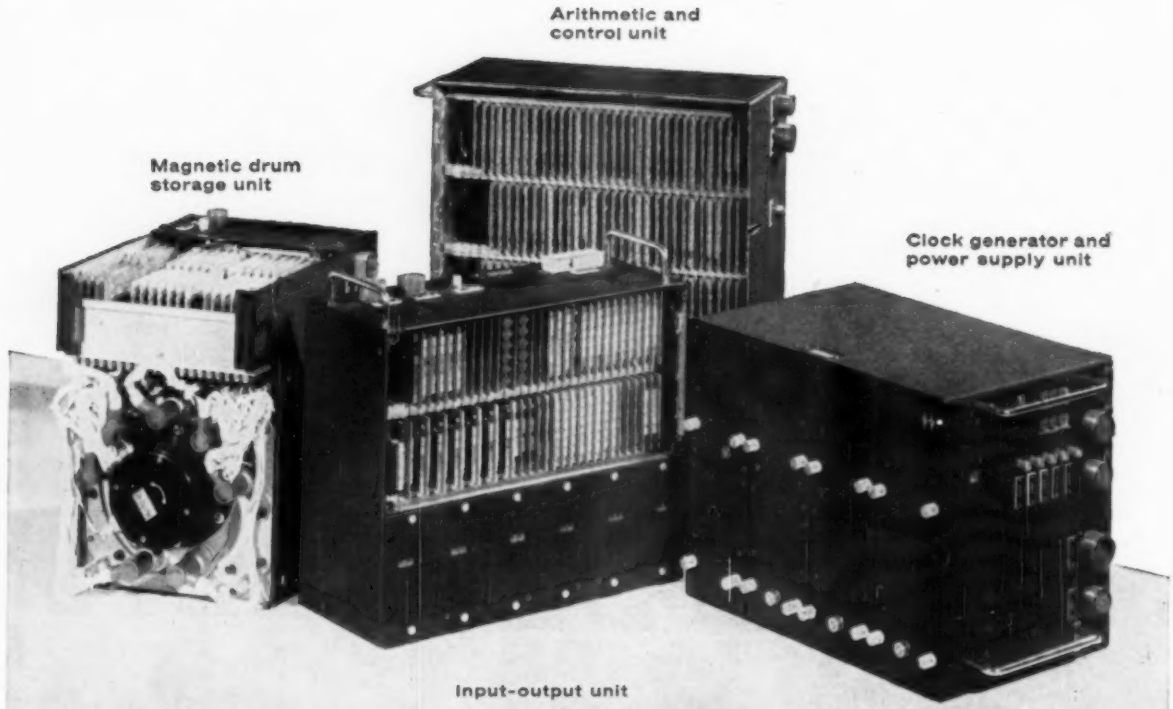

The Importance of
DIGITAL TECHNIQUES

Digital techniques constitute one of the important developments which have made possible the recent advances in computers and related equipment for computation, data processing, and industrial and military electronic control.

Digital computers for scientific computation range from small specialized units costing a few thousand dollars, to large general-purpose computers costing over a million dollars. One of these large computers is a part of the Ramo-Wooldridge Computing Center, and a second such unit is being installed early this year.

Electronic data processing for business and industry is rapidly growing based on earlier developments in electronic computers. Data processors have much in common with computers, including the utilization of digital techniques. A closely related field is that of industrial process control. To meet the needs in this field, Ramo-Wooldridge has recently put on the market the RW-300 Digital Control Computer.

The use of digital techniques in military control systems is an accomplished fact. Modern interceptor aircraft, for example, use digital fire control systems. A number of Ramo-Wooldridge scientists and engineers have pioneered in this field, and the photograph above shows the RW-30 Airborne Digital Computer.

The RW-30 is an example of what can be accomplished through the application of digital techniques in conjunction with modern semiconductor components. It performs complete mathematical operations, including multiplications, at the rate of 4000 per second (as fast as large scientific computers). Yet it occupies only 4.19 cubic feet, weighs 203 pounds and uses 400 watts power. It is packaged in four separate units to facilitate installation in aircraft. The magnetic drum memory has a capacity of 2607 21-bit words.

The versatility inherent in digital techniques makes it possible for the RW-30 to handle such varied military aircraft problems as navigation, armament control and bombing, and combinations of these problems, without changes in the RW-30 itself.

The RW-30 also serves to illustrate the balanced integration of systems analysis and product engineering which is a principal objective at Ramo-Wooldridge. Similar programs are in progress on other airborne and electronic control systems, communication and navigation systems, and electronic instrumentation and test equipment. Engineers and scientists are invited to explore openings in these fields at Ramo-Wooldridge.

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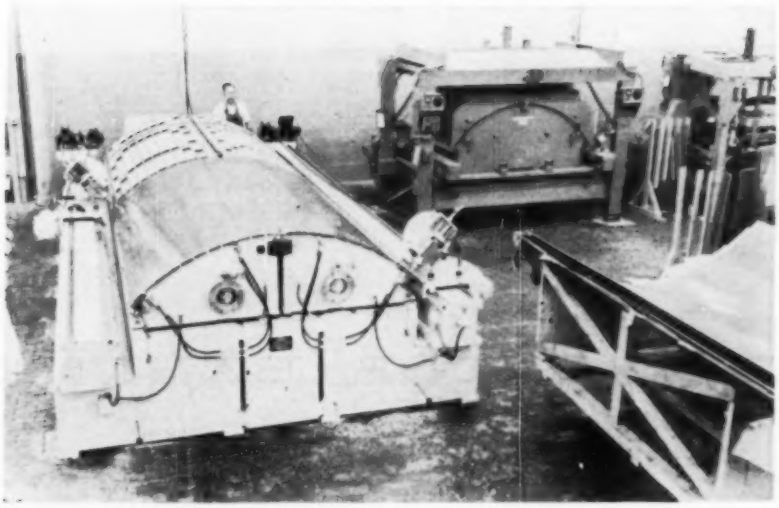


TITAN ICBM fuel tanks are shown being prepared for weld fabrication by automatic milling machines. Photos hint at the large size of the missile being built by the Martin Co.

How Titan Fuel Tanks Are Welded

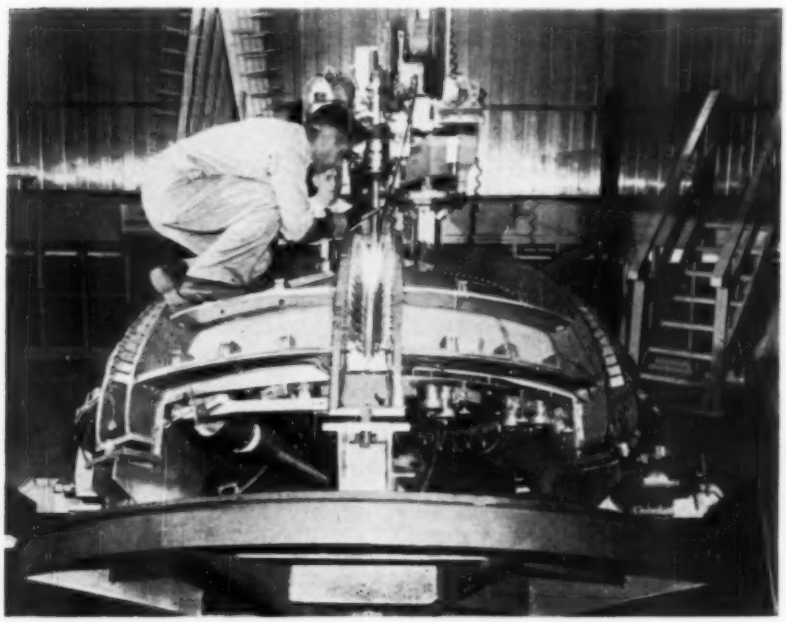
Largest precision welding tool installation ever engineered in this country is now in operation at the Martin Co., Denver, Col. Specifically designed for the construction of the Titan intercontinental ballistic missile, the welding equipment was engineered by the Machine Welding Department of the Air Reduction Co., New York, N. Y.

Included in the installation are fixtures, rotation devices, loading mechanisms and other parts of the welding machine tool such as welding heads, remote controls and welding power sources.

Heliwelding, an inert gas arcwelding process, is the method used in weld-fabricating the aluminum sections of the missile fuel tanks.

Technician in lower photograph is inspecting the weld while the automatic operation is in progress.

The Martin installation is one of 40 custom-engineered by Airco's Machine Welding Department since its inception in 1955.



FIRST photos released of fabrication of the Martin Titan, being built for Air Force, show "orange peel" sections being arcwelded to form part of missiles fuel tanks.

New Aeroquip Strap with Ratchet Buckle

FOR AIRCRAFT CARGO CONTROL

At Lockheed Aircraft Corporation, the new Aeroquip 5000 lb. Ratchet Buckle is used to hold the forward flight section of the prop-jet Electra on a rolling platform during production stages. An easy-tensioning and quick-release buckle, it actually takes up to 4 feet of slack under introduced load, and at the same time, introduces a tension that can reach up to 500 lbs. Operates as a miniature winch . . . can be used with any length webbing. There are all kinds of manufacturing and cargo applications. Return the coupon for full information on this and other types of cargo control strap assemblies.

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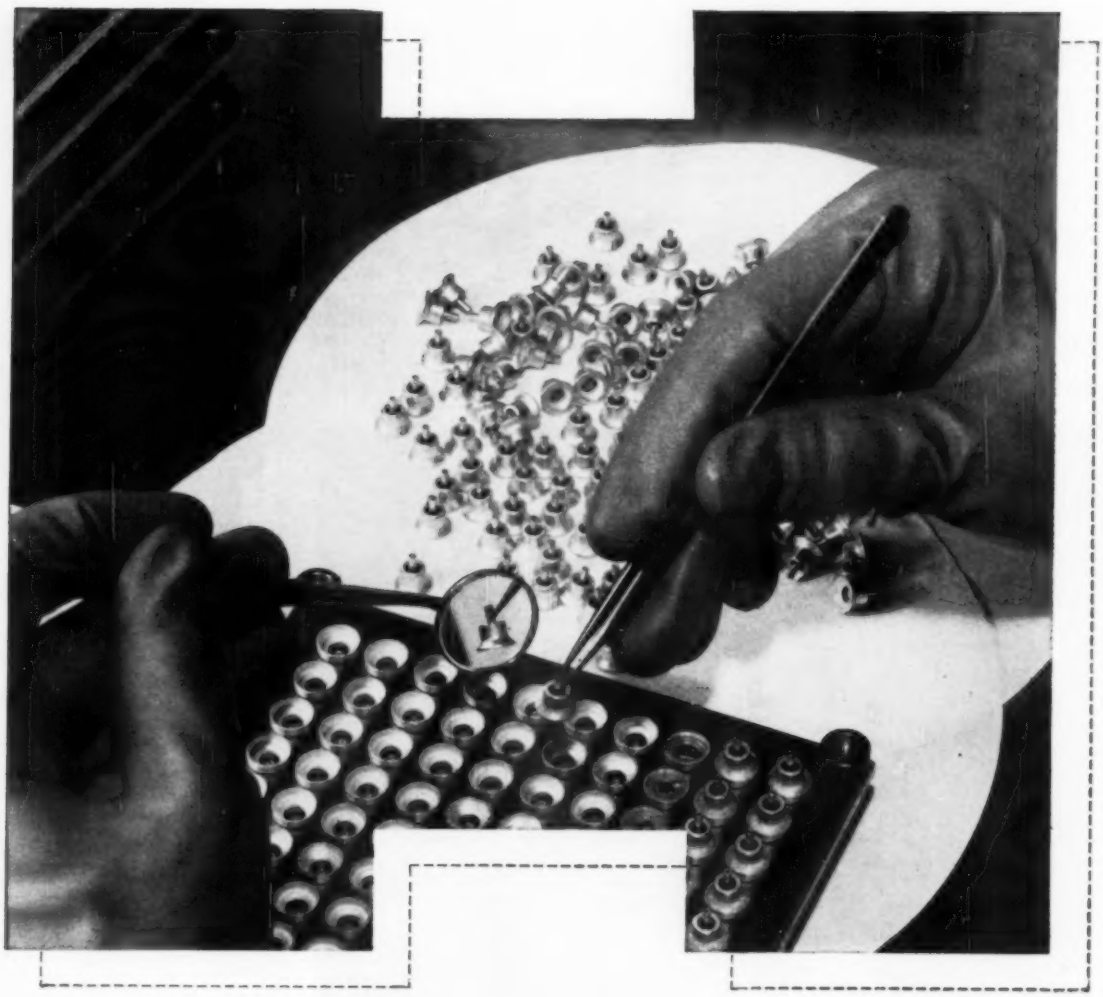


WITH A LONGER LIFE-SPAN

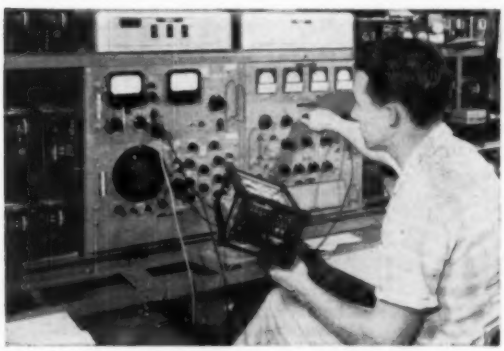
Reliability . . . one of the electronics industry's most pressing problems. Today, a system must not only work efficiently—it must often perform operations under highly adverse conditions.

Hughes Products, the commercial activity of Hughes, markets a wide variety of reliable systems and components to industry . . . ranging from semiconductor devices, electron tubes, instruments and electro-mechanical components, to control systems. In order to establish tight quality control, all functions—research and development through manufacturing—are performed by Hughes Products personnel.

One important phase in producing reliable products is careful control at each step in the manufacturing process. The assembly of the tiny Hughes transistors shown at left, for example, is carried out under glass in a dust-free, moisture-free atmosphere. The care given these "incubator babies" assures the quality needed for reliable performance.

Reliability is given high priority in *every phase* of the Hughes operation. Years of study and experiment—in research, development, and manufacturing—have given Hughes electronic armament systems, radar warning systems, guided missiles, and commercial electronics products a reputation for high standards of performance under all kinds of conditions.

The constant advance of Hughes into newer and more challenging fields benefits the present and prospective employee by assuring him an opportunity to progress with a leader in his field.



Precise evaluation of highly complex electronics armament systems requires that manufacturing engineers design and develop test equipment frequently as complex as the system being tested.

Setting the stage for new product developments, the Hughes Research & Development Laboratories delve into basic theory. Here R&D engineers work with a slot-array microwave antenna.

Highly rewarding positions are now open for experienced engineers, including the areas of:

Circuit Design	Systems Analysis
Reliability	Semiconductor Applications
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CATAPULT crew prepares F8U-1 for launch from catapult No. 3 amidst steam caused by previous launch from catapult No. 4.

F8U-1s Begin Duty on U.S.S. Saratoga

By Erwin J. Bulban

Aboard U.S.S. Saratoga—Some 3,500 officers and men of this 60,000-ton-plus supercarrier are battling a host of problems preparing for eight months of duty guarding the vital Mediterranean waterway, only 40 min. distant from Russian jet bases.

During a week at sea some 250 mi. off the giant carrier basin at Mayport, Fla., crew and airmen attempted to prepare for a stringent Navy operational readiness inspection planned to test whether the Saratoga and the accompanying U.S.S. Essex were shipshape to replace the U.S.S. Forrestal and U.S.S. Randolph in the Near East.

Carrier Problems

Among the problems facing Adm. Clifford S. Cooper, commander of Carrier Division 6, and Capt. Alfred R. Matter, commander of the Saratoga:

• **Low experience level** of the crew, new hands running some 30% to 50% in many departments and many having no previous carrier duty.

• **Need to break in** a new carrier air group, which includes VF-32, flying the first fully operational squadron of Chance Vought F8U-1 Crusaders to come aboard a carrier.

• **Unseasonably cold** and stormy weather which riddled the planned heavy flight training and indoctrination schedule.

In addition to VF-32's Crusaders, the 77 aircraft of Carrier Air Group 3 aboard Saratoga (CVA-60) include McDonnell F3H-2Ns of VF-31, Douglas A3D-2s of VAH-9, Douglas A4D-1s of VA-34, Douglas AD-6s of VA-35 and a handful of AD-5Ns and AD-5Ws of VAW-12 and VAAW-33 and Grumman F9F-8P Cougar photo planes of VFP-62.

On Essex is Air Task Group 201 comprising F3H-2Ns of VF-11, North American FJ-3s of VF-62, Douglas A4D-2s of VA-83, AD-4s and AD-6s of VA-105 and North American AJ-2s of VAH-7 along with some AD-4Ns of VAW-12 and VAAW-33. AJ-2s are tankers used to refuel combat air patrol planes and were scheduled to stand by for emergency refueling.

Performance of the Crusader is ahead of all other fleet fighters in range, speed and altitude capabilities, Adm. Cooper noted, adding that the F8U teamed with the Navy's Sidewinder infrared homing missile is a "terrific instrument." Crusaders on the Saratoga carry two Sidewinders each on racks on either side of the fuselage behind the cockpit. This type of mounting was chosen by Chance Vought because it preserves the integrity of the thin wet (integral fuel tanks) wing; also, closer location to the airplane's center line provides improved initial aiming, company personnel noted.

High cost of modern fighters limits numbers that can be procured under current budgets; their size also limits the number that can be carried even

on large carriers such as the Saratoga—as a result, VF-32's 12 F8Us represented total squadron strength, and no spares are aboard. This requires that the airplanes show a good reliability record. Even under the handicaps encountered operating the first week aboard the carrier, VF-32 maintained a good availability, only two of the Crusaders being out at any one time, AVIATION WEEK was told.

Systems are laid out to provide easy accessibility; major portion of wiring from cockpit passes back along one side of the fuselage, hydraulic lines on the other side and they cross over in an easily accessible utility compartment behind the cockpit. Majority of the 3,000 psi. hydraulic system's valves are located in a compartment in the belly, forward of the main gear well. Instrument panel can be rotated forward permitting easy access to this critical area.

VF-32 handled its Crusaders smoothly on the deck of CVA-60. Pilots like the comforting feel of the high-powered J57 with afterburner, got away easily on waveoffs, "bolters" (tailhook missing the arresting cables). Variable incidence wing also made catapult launch takeoffs seem smoother, the aircraft climbing away without the mushing apparent in other types.

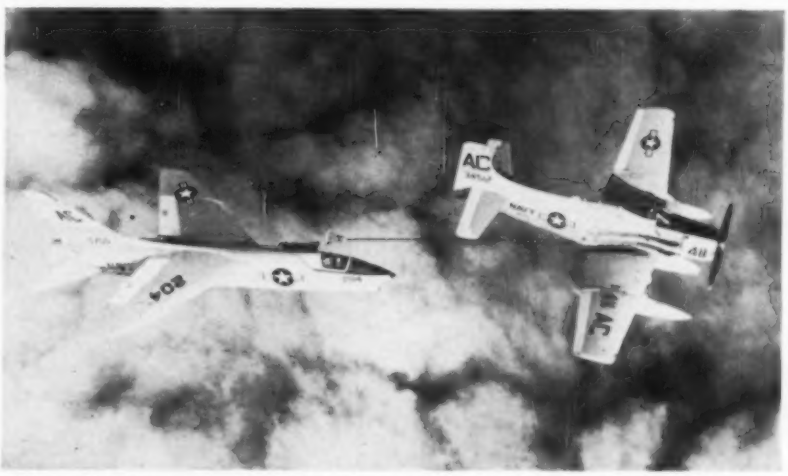
Crusaders and A4D-2 Skyhawks of Essex, latest types to join the fleet, are fitted with air-to-air-refueling probes. The Crusader's is a retractable installation housed in a streamlined bulge on the port side of the fuselage aft of the cockpit; the Skyhawk's is a fixed, long external probe on the starboard side. Both types use AD-6s fitted with "Buddy" refueling gear to stretch their range; in the case of the A4D-2, the Skyraider tanker carries sufficient fuel to provide it with almost full tanks.

A4D Is Improvement

A4D also is a distinct improvement of earlier attack types, such as F9Fs used for attack missions, according to Adm. Clifford. He noted that the Skyhawk has improved bomb load and increased range over the F9F, also is easier to handle on the deck because of its smaller size. Latter point was readily apparent while watching plane handlers spot the aircraft; for one thing, the delta wing configuration permits close stacking of planes, leading edge to leading edge.

Simplified cockpit presentation is a particular characteristic liked by pilots. One pilot pointed out as an example the oil pressure indicator—a printed presentation that tells him whether pressure is normal, too high or too low. Direct-reading gages are fine for the engineering types interested in compiling data, but carrier pilots are primarily

CREW of U.S.S. Saratoga, lined up for personnel inspection at sea, are viewed from off the port bow. Aircraft spotted forward include F3H-2Ns, F2H-4s, ADs and F9F-8s. A3D attack bombers are spotted aft. Tacan gear is visible atop radar mast.



F8U-1 of VF-32 is refueled in flight by AD-6 of VA-35 demonstrating buddy system flight refueling. AD-6 carries three large external fuel tanks.

FLIGHT deck crews are respotting the deck. F3H-2N Demon is visible behind three F8U-1s. Aircraft Nos. 208 and 204 are in position for catapult launch.

concerned with a simple "go-no go" answer, he stated.

Pilot comments indicate that the Skyhawk handled nicely; one thing that requires close attention immediately after landing is a tendency of the airplane to go to the left, following the free-castering non-steerable nose gear which rotates left plus the tendency of the airplane to ride very lightly on the nose gear.

Saratoga's Catapults

For launching jets, Saratoga has four Bliss steam catapults, two 250-ft. C-11s on either side of the forward deck, two 200-ft. C-11 Mk.Is on the angled portion of the port flight deck. Steam from the ship's boilers is stored in accumulators at 550 psi.; firing pressure varies, depending upon the type of aircraft launched. F8U, for example, takes about 300 psi., smaller planes between 150-200 psi. The A3D takes about 500.

This capacity gets the fully loaded A3D, which grosses about 70,000 lb., up to 142 kt. at the end of the catapult; the F8U gets up to 180 kt.; the A4D, 150 kt. A Regulus II guided missile, one of which has been launched by the Saratoga, is shot off at 200 kt. Average speed at the end of the catapult is calculated at some 10 kt. above minimum required airspeed.

Planes can be spotted on any of the four catapults, although normally the A3D is not launched from the No. 1 catapult, which is in line with the island, except during trials. Reason is that the rotating, retractable jet blast fences behind the catapults are designed for single-engine types; pod-mounted J57s of the A3D would blast the island area.

Modified blast fences with three-section hinged gates, are planned for installation to permit greater versatility in launching the big A3D, AVIATION WEEK was told.

Picket Duty

Piston-engine AD-5s make normal takeoffs. AD-5Ws of VAW-12 are used as radar pickets, extending the range of the carrier's normal warning radar gear. Primary mission is to alert the carrier to low-flying attacking aircraft trying to sneak in under the carrier's radar; secondary job is anti-submarine warfare. Missions normally last some 3¼-4 hr., with the planes orbiting in their search patterns at approximately 2,000 ft. One of the Navy's largest units, VAW-12 has some 150 officers and 63 aircraft, from which it supplies picket aircraft for all carriers serving the Atlantic fleet.

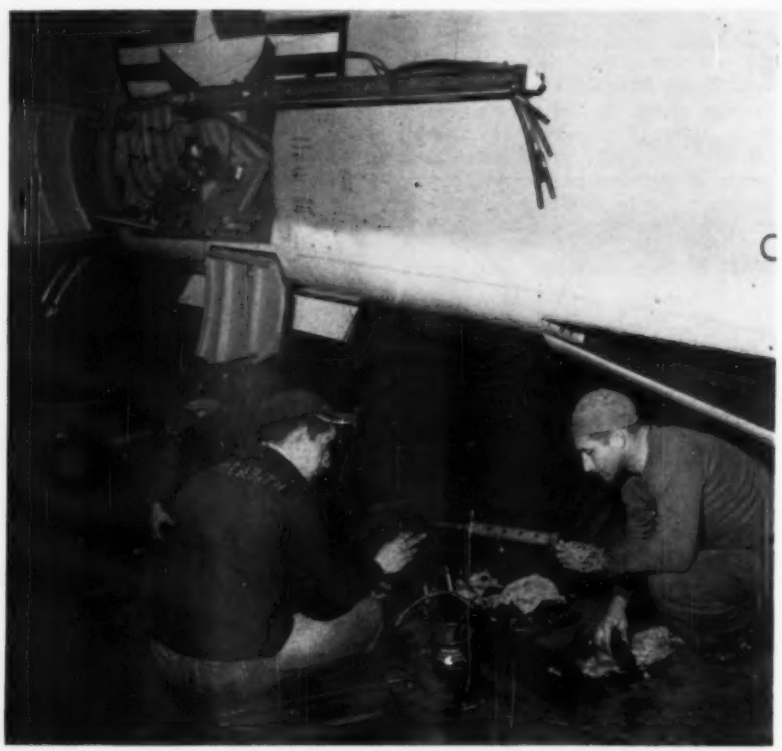
Defense of the ship rests primarily with the fighter squadrons—CVA-60's defensive armament is puny compared even to its World War II namesake. Plans call for replacing guns with surface-to-air missiles.

With squadrons kept down to the minimum of aircraft needed and no spare planes carried, stocking necessary volume of spare parts to provide pull-and-replace maintenance is one of the sorest problems on the giant carrier.

Aviation Stores Division of Supply Department is responsible for airframe, powerplant and all electronics spares; in addition maintains inventory control of jet fuel, aviation gasoline and oils and hydraulic fluids.

Inventory, less fuels and oils, runs some $3.5 million.

F8U-1 Crusader from Squadron VF-32 takes "catshot" from port catapult of U.S.S. Saratoga. Variable position wing is visible in slow speed attitude.



ORDNANCE crew services cannon of F8U-1 on hangar deck of Saratoga. Rack on side of aircraft above open access door is for Sidewinder missiles.

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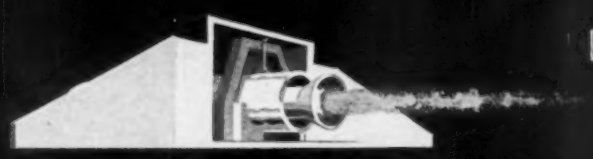

At its new Utah Division, an 11,000-acre, company owned facility, THIOKOL is capable of producing solid propellant rocket engines of unprecedented size and power — engines that may hold the key to our country's operational IRBM and ICBM missiles.

THIOKOL is the only manufacturer of large solid propellant motors having the performance capabilities and flight-proven reliability required by large, long range missiles. Almost 100% reliability has been proved in hundreds of flight tests.

THIOKOL power plants propel the operational Nike-Hercules, Sergeant, X-17 and other large missiles as yet unclassified.

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Indications are that storage space for spare aircraft material is a critical spot on even such a large carrier as Saratoga —Aviation Stores Division maintains some 20 storerooms and has available additional 20 storage spaces.

Inventory Difficulties

But one of problems mentioned often in discussions with the numerous manufacturers' technical representatives aboard was their inability to locate material that had been brought aboard. One such representative told AVIATION WEEK that to overcome this problem, he had personally supervised loading and storage of his material and made up lists showing what type of material was stored where, so that squadrons could quickly find needed parts.

Representatives from Avionics Division of BuAer packed their material in kits covering complete inventories for various types of planes and personally supervised their loading. Inventories in stock were off-loaded, they said. They hope to introduce this system to other carriers.

Attempt to meet heavy training schedules in preparation for operational readiness inspection was severely handicapped by stormy weather, which also punctured plans for night flying operations.

In addition, low experience level of the flight deck crews slowed the pace of planned flying. This was most noticeable the first few days; near the end of the week operations were going noticeably smoother.

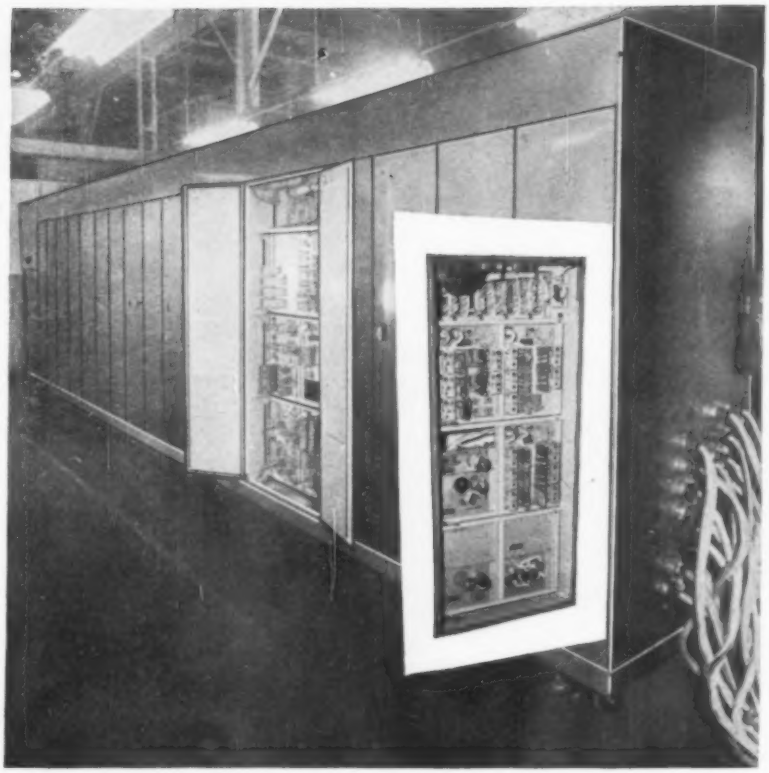
Ship's officers said that by the time the ship arrived in the Mediterranean, in some three weeks time, the team would be developed to a high level of proficiency.

Inexperienced Personnel

Aircraft handling officer noted that he had some 50% turnover in his 600 personnel working the flight and two-acre hangar deck, and many had never seen an airplane land on a carrier. This was noticeable at first in the time it took to get planes ready on catapults, cases of too many people moving in to do a particular job and then getting clear in an almost leisurely manner, further slowing operations. When an A4D lost a fuel cap on catapulting, deck crew was slow in getting to the airplane when, after the landing, fuel poured out causing a momentary flash fire that nearly enveloped the entire plane.

Fire hose snagged and was delayed in reaching the airplane, as was the pilot's ladder.

During this period of shakedown, harassed officers and many crewmen were getting only three or four hours of sleep a day, in some cases slept on cots near their work.



complete electronic and mechanical assemblies

ERCO

Encompassed in the scope of Erco's manufacturing operations are standard and custom-designed electronic and mechanical assemblies.

Long experience in the sheet metal and electronic industries has made Erco expert in both fields of endeavor. Illustrated above are two custom-built racks complete with electronic assembly ready for insertion into a trailerized* computer. These units are indicative of the precision electronic assembly and intricate metal working carried on at Erco.

You'll find that it is economical to consult Erco for the design and fabrication of complete electronic and mechanical assemblies. Erco offers you two major advantages as an electronic and mechanical subcontractor — advanced engineering experience and talent that has solved thousands of assembly problems and — one-quarter million square feet of manufacturing facilities concentrated under one roof.

Send Erco an outline of your problems in these fields or write today Dept. MS, Riverdale, Md., for more details. They are given in the brochure "Erco — Production Facilities."

*Erco also built the trailer.

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NAPIER ELAND TURBO-PROP ENGINES POWER THE FAIREY ROTODYNE

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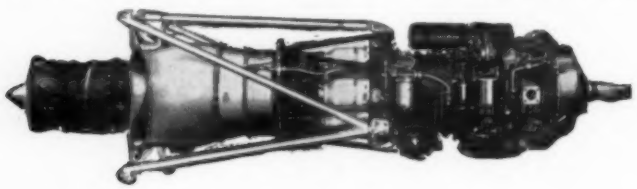
VERTICAL TAKE-OFF
AIRLINER

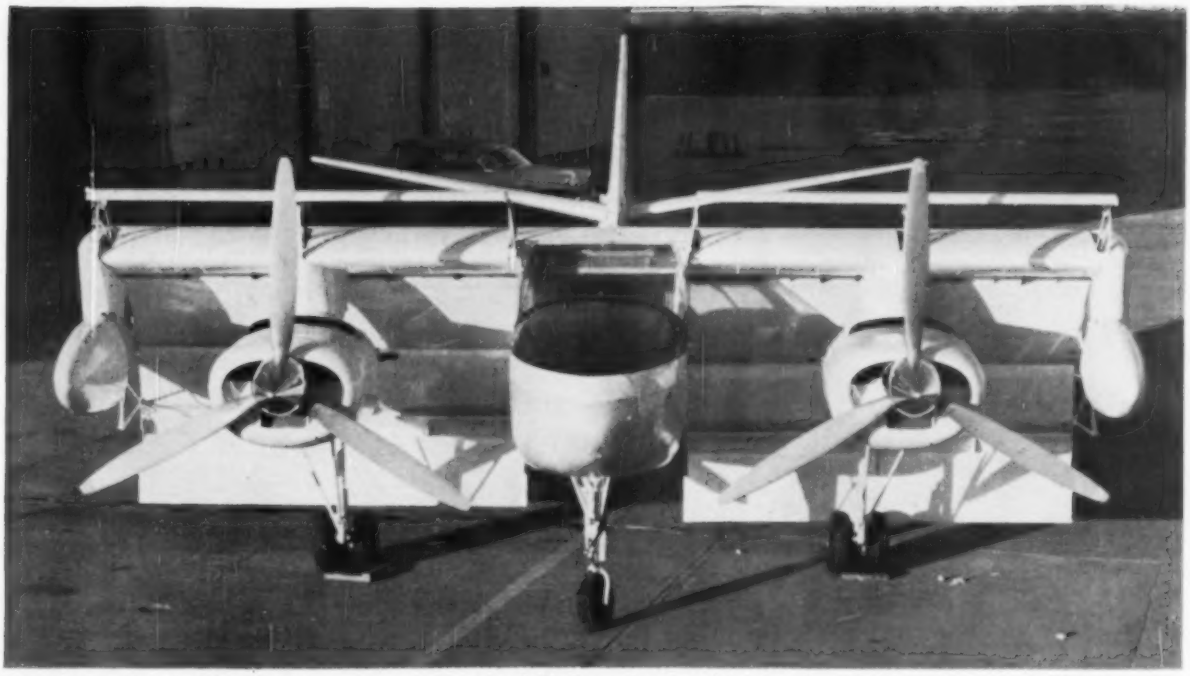
A basic factor in the selection of these engines was their ability to provide power to the propellers for forward flight and compressed air to the rotor tip jet units for vertical flight.



NAPIER Eland turbo-prop D. NAPIER AND SON LIMITED, LONDON, W.3.

A Member of the ENGLISH ELECTRIC Aviation Group

CRC 836



ROBERTSON Aircraft Corp.'s VTOL prototype uses vectored slipstream, is powered by supercharged 340-hp. Lycoming GSO-480 engines.

Robertson VTOL Makes Tethered Flight

Ft. Worth, Tex.—Tethered flight trials started here Jan. 8 on a new vectored slipstream type vertical takeoff and landing airplane designed by Robertson Aircraft Corp., a subsidiary of Aero Design & Engineering Co.

Developed as a private venture, the aircraft is aimed at the military market and has been shown to military representatives. Designers say they are confident the test aircraft "will open a new realm in fixed wing aircraft flight."

Robertson VTOL is a four-place aircraft and has a high speed cruising range of about 1,000 mi. Robertson skipped the flying test bed stage and has produced a prototype designed as an operational airplane.

It is powered by supercharged 340-hp. Lycoming GSO480 engines and can be adapted to turboprop operation in the future.

The VTOL utilizes a vectored slipstream and conventional controls. Extensive flap system used for hovering retracts into a low aspect ratio wing in cruise configuration. The aircraft employs a sliding flap, and all control comes from the double-slotted full span trailing edge flap.

Leading edge shroud used on the VTOL is a boundary layer device which provides trim equilibrium. This is a technique National Advisory Committee for Aeronautics advises for use in hovering and transitional flight.

ALL fuel and oil for four-place VTOL is carried in the tip tanks which double as end plates. End plates increase cruise efficiency of the low aspect ratio wing in cruise configuration.

All fuel and oil for the VTOL is carried in the tip tanks which double as end plates to increase cruise efficiency of the low aspect ratio wing in cruise configuration.

End plates also improve characteristics in ground effect, and carrying fuel and oil in the tips simplifies cooling problems.

Robertson Aircraft Corp. was formed in October, 1956. On the basis of his VTOL design proposal, designer James Robertson reached an agreement two months later in which Aero Design acquired control of Robertson Aircraft, and the company became an Aero Design research and development subsidiary.

The VTOL project started as a pure research project. Aero Design has invested about $200,000 in the project so far.

Eimac Ceramic Tetrodes are the Best Approach to the Advantages of SSB

The growing demand on available spectrum space makes single sideband operation increasingly attractive in aeronautical communications. SSB operation allows the same amount of intelligence to be transmitted in one-half the bandwidth required for conventional AM transmission. Longer range is possible with greater signal-to-noise ratio and reduction of interference from other signals. Reliable communication with lower average power in the final rf stage results in substantial reduction in total weight and cost of SSB transmitting equipment.

A modern Class AB_1 linear amplifier is the ideal way to raise an SSB signal to the desired power level with stability and no distortion. Zero grid drive requirement minimizes driver stage design problems and eliminates distortion from this source. The 4CX250B, 4CX300A, and 4CX1000A shown above are especially well-suited for airborne use in Class AB_1 operation. The 4CX5000A is ideal for high power ground station use. These tubes offer the high power gain, low distortion, and stability needed for Class AB_1 operation. And, each has performance-proved reserve ability to handle the high peak powers encountered.

Eimac ceramic design gives these tubes the compactness, ruggedness, and high reliability demanded in exacting aeronautical applications.

Write our Application Engineering Department for a copy of the technical bulletin "Single Sideband".

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CLASS AB_1 SSB OPERATION

	4CX250B	4CX300A	4CX1000A	4CX5000A
Plate voltage	2000 v	2500 v	3000 v	7500 v
Driving Power	0 w	0 w	0 w	0 w
Peak Envelope Power	325 w	400 w	1680 w	11,000 w

Turbine Integration Challenge to Industry

London—Complete integration of turbine engines with some form of boundary layer control is a major challenge in future jet transport design, A. A. Lombard of Rolls-Royce Ltd., recently said before the Royal Aeronautical Society.

Other points made by Lombard included:

- **Certainty that impetus** of the high efficiency turboprop engine would enable air freight rates to compare with road haulage on a competitive cost basis.
- **High pressure ratio** bypass turbojets needed for ranges above 500 mi. would soon be announced.
- **Likelihood of 10%** improvement in fuel consumption will be offered above that of Boeing and Douglas jet transports.
- **Without military demand** high engineering costs of supersonic airliners would keep them out of commercial service for "a number of years."
- **Military nuclear aircraft** have very distant prospects and commercial nuclear aircraft can be ruled out.

Discussing the integration of engine and aircraft, Lombard echoed many of the advantages advanced recently by Dr. Lachmann of Handley Page Ltd. Handley Page has been operating a sucked boundary layer giving laminar flow on a Vampire aircraft. This company is now believed to be ready to go ahead on a 30,000 lb. civil aircraft with a full chord laminar flow wing using suction.

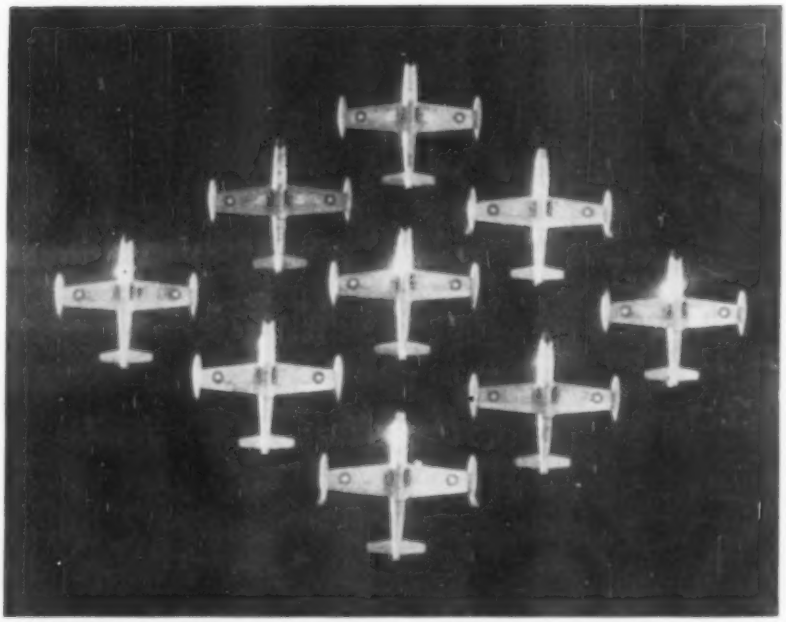
Lombard stated that up to 100% increase in lift coefficient was possible, leading to a 30% reduction in gross weight and a 20% reduction in direct operating costs.

The jet engine, when cruising at Mach 2.5, has an overall efficiency value of 38%, Lombard said. If a satisfactory lift-drag ratio can be achieved, long range flights at these speeds will become an economic possibility, he said.

To meet this requirement, he said, aircraft and engines would need to be optimized at this speed and landing and takeoff requirements ignored.

The low lift coefficient required would be met by a highly swept delta fuselage having a leading edge well behind the Mach angle, high wing loading with low skin friction and minimum parasitic drag. Lift augmentation would be needed at takeoff; jet lift was proposed and had already been demonstrated by the Flying Bedstead made by his company.

Lombard said that its development would be very expensive and so was likely to delay such a scheme for years.



CHINESE NATIONALIST pilots flying Republic F-84Gs are shown at bottom of a loop.

THUNDER Tigers make a pass over field in air show, holding nine-plane diamond formation.

Chinese Fly Nine-Plane Diamond

Republic of China's precision acrobatic team, the Thunder Tigers, is flying a nine-plane diamond formation of Republic F-84Gs. Organized in August, 1954, the Chinese Nationalist pilots made their first off-island appearance in December of that year participating in an Aviation Week air show in the Philippines. In 1956 the team came back to the Philippines, having increased its diamond from an original four planes to six. Public reaction to the six-plane formation was enthusiastic, but when the Nationalist pilots heard that other teams also were flying six-plane diamonds, they became dissatisfied.

It was at this time that the Thunder Tigers developed a nine-plane "super diamond." Making their third appearance against other teams in the Philippines on Dec. 15, 1957, the Thunder Tigers flew their nine-plane formation through loops, barrel rolls, steep turns and a bomb burst which was followed by a low pass over the field and a join-up. Their unusual performance drew

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Bell has built more helicopters than any other manufacturer. The 2,000th edition of the distinguished 47 model series, the Bell Ranger, has rolled off the assembly line and joined the hundreds of other Bells at work for many of America's best-known companies. In the Armed Services, in business and industry, it's the most widely-used helicopter in the world.

For the Bell 47 represents 2,500,000 hours of flying experience.. the equivalent of almost 300 years of flight time. It has stood not only this *test of time*, but has proven its ability in true-life tests of climate, altitude and terrain in 52 countries.

From its military success on the battlefields of Korea, the Bell has gone straight to commercial success in hundreds of peace-time uses. In such fields as oil, manufacturing, construction, utilities and agriculture, as well as in defense work, the Bell is proving its worth, paying its way, many times over.

And the Bell 47 continues to be lowest in initial cost, lowest in maintenance, longest in service life between overhauls ..and most advanced in operational features. Look to the 2,000th Bell, and the thousands that will follow, for continued leadership.

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enthusiastic acclaim from the onlookers.

The Chinese pilots fly line aircraft, the same aircraft in which they occasionally engage Communist jets along the mainland coast. The planes are combat ready, except that ammunition usually is removed from guns—an exception being when they perform locally at Taiwan. The pilots are members of a combat unit and have many duties besides acrobatics. Nothing special in the way of equipment or maintenance is given the team.

Capt. Sidney S. Yahn, USAF, is assigned as Military Assistance Advisory Group Operations Adviser to the unit to which the Thunder Tigers belong. He has flown approximately 800 hr. with the Chinese pilots during the past 21 months.

Standardization, Closer Tolerance Needed in Production Calibration

By Michael Yaffee

Bedford, Mass.—One-millionth of an inch can make a big difference in U.S. military capability. Just how much this invisible line means to this country's military might was the theme of the 13th Annual Meeting of the Dimensional Standards and Metrology Division of the American Ordnance Assn. held here at the Air Force Cambridge Research Center.

One-millionth of an inch is the highest accuracy with which the National Bureau of Standards has been able to calibrate and certify master gage blocks. For years, these gage blocks have served as reference standards for controlling production tolerances to a ten-thousandth part of an inch. Until recently, such tolerances adequately met the demands for accuracy and reliability needed in weapon technology.

But the advent of new, high-performance weapon, detection and control systems has outmoded these standards.

Today, the demand is for control of production tolerances to within a hundred-thousandth part of an inch. This, in turn, means master gage blocks that can be calibrated and certified to one or two ten-millionths of an inch. To maintain this accuracy and reliability from the production line to the military base, it also means the establishment of field facilities with test equipment and measurement standards having accuracies heretofore found only in precision metrology laboratories.

Programs in Progress

Well aware of this need for greater precision, the more than 300 metrologists who attended the meeting wanted to know what was being done about it.

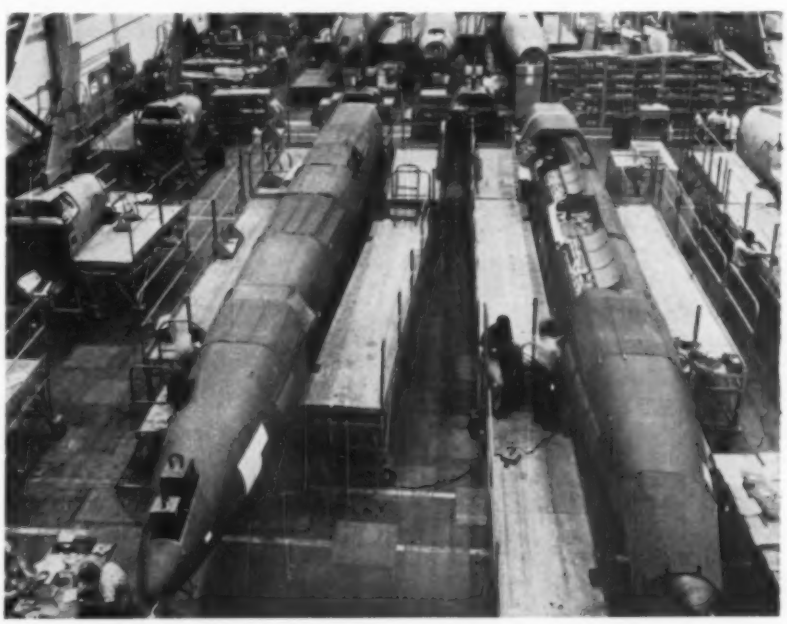
For one thing, said A. V. Astin, director of the National Bureau of Standards, the Bureau is making good progress on the development of the more precise standards required. Dr. Astin believes that by 1960 the major national standardizing laboratories throughout the world will agree on using the wave length corresponding to a specific energy transition in a specific atom (currently favored: the orange line of krypton 86) as the ultimate standards for all length measurements.

Meanwhile, Dr. Astin pointed out, there is need to standardize the inch among the "three major English-speaking and inch-using countries," the United States, England and Canada. The fractional differences in the three inches (respectively: 2.540005 cm, 2.5399956 cm, 2.539999 cm) created confusion and inefficiency during World War II in the exchange and mutual use of precision instruments and components. And with today's trend toward ever increasing precision, the inefficiency and confusion would be compounded in the event of future interchanges.

To end this mix-up in measurement standards, Dr. Astin proposed that the major English-speaking nations adopt as a standard an international yard exactly equal to 0.9144 meter. This, in turn, would establish an international inch exactly equal to 2.54 cm. By unanimous voice vote, the American Ordnance Assn. agreed on the spot to support Dr. Astin's proposal.

In the Soviet Union, Dr. Astin said, the value and importance of precise measurement is fully appreciated. The Soviet's sixth Five-Year Program (ending in 1960), for example, has among its chief objectives the following: Establishment of a total of 129 calibration centers which will pass on the accuracy of all instruments used in Russian laboratories and plants; tripling of production of instruments for all forms of measurement; and the erection of 100 additional plants for producing metrological instruments.

The greatest single impetus behind this drive for greater precision both here and in Russia undoubtedly stems from the fast growing importance of missiles. Robert Cuthill, deputy director of the Army Ballistic Missile Agency's Industrial Operations Division, discussed the importance of accuracy in the manufacture of large ballistic missiles which contain 6,000 to 10,000 line items and 20,000 to 30,000 component parts. In using electrical calibration standards for example, Mr. Cuthill pointed out that Army Ballistic Missile Agency establishes its frequency standard by comparison with the National Bureau of Standard station WWV, to an accuracy of plus or minus



Snark Missiles on Production Line

Snark intercontinental guided missiles take shape at Northrop's Hawthorne, Calif., plant. Air Force's first Snark squadron will be based at Presque Isle AFB, Me.

THE ARMY H-23D . . .
HELICOPTER WITH *TOMORROW BUILT IN*

Design of the basic H-23 helicopter was largely governed by a doctrine of *ruggedness*. It has produced a dependable helicopter, with a record of safety unequalled in its class.

Now, in the H-23D, a completely new 1000-hour+ drive system is introduced, seen as a major break-through in lower operating costs. A full-time 250 horsepower is available and, significantly, without "redline" restrictions warning of jeopardized service life. Thus, *ruggedness* has also afforded *growth potential*.

In the H-23D, growth potential assumes a new importance. Its existing components are *designed* to accept even greater power increases for the future's most challenging performance demands. Now, more than ever, the Army H-23 is an investment in *tomorrow*.

HILLER HELICOPTERS **PALO ALTO, CALIFORNIA**

one part in 8x10⁶.

Precise measurement is also very important in the assembly of the smaller, unguided missile, asserted Robert Leard of the U.S. Naval Ordnance Test Station. When a rocket is unguided, the matter of thrust alignment is of the utmost importance. Whether the rocket is launched from ship, plane or ground ramp, it is essential that the thrust axis runs directly through the center of gravity.

Air Force Measures Up

The Air Force has assigned responsibility for its calibration system to the Air Materiel Command. Primarily, this involves the control of test equipment and measurement standards used to sustain accuracy and reliability of weapon systems.

The importance of this work should be readily apparent, declared Col. J. G. Schneider, USAF, chief of quality control. Recently, a flight of Strategic Air Command tanker aircraft missed its refueling rendezvous with a group of B-47 bombers, due to errors in navigational instruments introduced by faulty test equipment. Imagine the consequences, said Col. Schneider, if that miscalculation had occurred on an actual combat mission requiring extended over-water flight.

Air Materiel Command's responsibility does not extend to an Air Force missile test center such as the one at Patrick AFB. But it will cover operational missile bases when they come into existence as well as radar stations and regular USAF bases. In fact, the Air Materiel Command plans to establish calibration facilities at 200 bases. The first center is already in operation at March AFB, Calif.

$25,000 for Each Base

Col. Schneider estimated that it will cost $25,000 to equip each base calibration center. Over the base facilities will be Air Materiel Command precision measurement laboratories located at eight field offices in the continental United States known as Air Materiel Areas. These Air Materiel Area laboratories, which cost $300,000 each to equip and are now operational, will provide calibration service to the base units.

The standards at each Air Materiel Area laboratory are calibrated once a year with transfer standards which are calibrated by the Air Force standards located at the USAF depot in Dayton, Ohio. Dayton AFD is in effect an Air Force Bureau of Standards.

The Dayton Standards are certified for accuracy by the National Bureau of Standards once a year. To speed up the calibration cycle, Air Materiel Command permanently stationed a calibration detachment at the National

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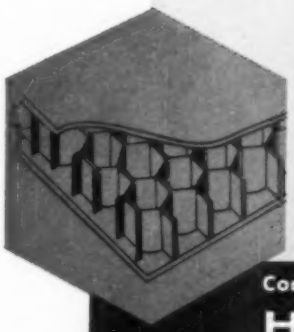

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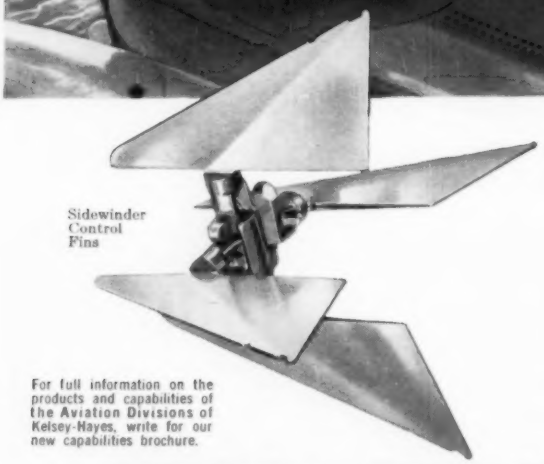

Sidewinder Control Fins

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target... enemy tail pipes!

The Navy's new self-guided, air-to-air missile, "Sidewinder," is so accurate that it can "home" in on and hit the tailpipe of a supersonic jet engaged in violent evasive action. Control fins for this deadly new missile are produced by the Aviation Divisions of Kelsey-Hayes Co., Detroit 32, Michigan.

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17 PLANTS: Detroit and Jackson, Mich.; Los Angeles; McKeesport, Pa.; Springfield, Ohio (Speco Division); Utica, N. Y. (Utica Drop Forge & Tool Division); Davenport, Iowa (Farm Implement and Wheel Division); Philadelphia (Heintz Division); Windsor, Ontario, Canada.

Bureau of Standards Center in Boulder, Colo., to monitor a standards exchange program between the Bureau and Air Materiel Area laboratories. In the future, each Air Materiel Area laboratory will send its standards directly to National Bureau of Standards at Boulder for calibration in exchange for a set that has already been calibrated.

Complicated and costly as this program appears, Headquarters USAF believes it is also vital to national defense and has given Air Materiel Command the go-ahead for its plans to implement the program. It seems, as one American Ordnance Assn. member remarked, that national survival now rests on a master gage block.

Rocket Researchers Registering Students

The Rocket Research Institute, Inc., has established a National Registry of Student Rocketeers so as to coordinate and advise on a national level the safe preparation by students of rocket training devices.

Students are requested to send to the Institute, name, address, age, school attended and name of science teacher.

Students making satisfactory progress will be invited, at the age of 18, to join the Rocket Research Institute. Additional information may be obtained by writing the Institute at 3262 Castera Ave., Glendale 8, Calif.

IAS, AAS to Present High Honorary Awards

Aeronautical and astronautical awards will be presented on consecutive evenings in New York City during the last week in January.

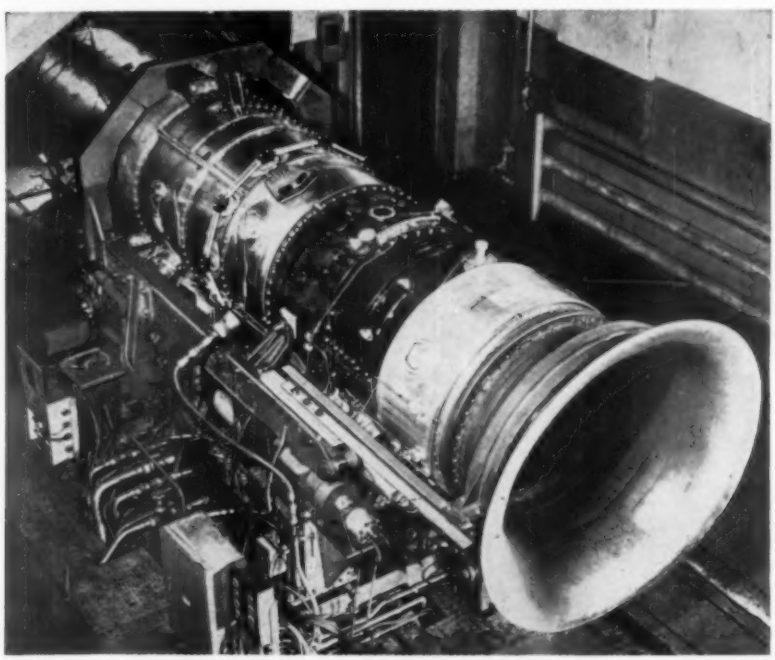
The Institute of Aeronautical Sciences will present its 1957 Honorary Fellows Award, the highest the Institute can bestow, to William Littlewood, American, and Bo K. O. Lundberg, Swedish.

Mr. Littlewood is vice president of Equipment Research, American Airlines. Mr. Lundberg is director, Aeronautical Research Institute of Sweden.

Presentation of the awards will take place on Jan. 28 at the Hotel Sheraton Astor.

Guest speaker for the occasion will be Sen. W. Stuart Symington.

The American Astronautical Society will present its Space Flight Award to Wernher von Braun, Army Ballistic Missiles Agency, Huntsville, Ala., and the Melbourne W. Boynton Award to Maj. David G. Simons USAF, Chief-Space Biology, Aero Medical Field Laboratory, Holloman AFB, N. M. Astronautical Society's awards will be given on Jan. 29, at Midston House. Guest speaker for the society will be Welcome W. Bender, vice president and director, Research Institute for Advanced Study, the Martin Co., Baltimore, Md.



Rolls-Royce Bypass Engine

Rolls-Royce Conway bypass engine has a military rating of 17,500 lb. thrust with a comparatively low fuel consumption. A derivative of this engine will power Britain's transatlantic jet airliner, the Vickers VC. 10 (AW Jan. 20, p. 41).

PUMP PRIMERS

by Arthur A. Nichols

Gerotor pumps as a power source for hydraulic servo systems

Some interesting new applications for Gerotor pumps have been developed in recent times involving specialized problems in hydraulic servo systems.

One of these problems took us into marine service where a new type of anti-roll fin was developed for a large ship. This stabilizer is a ponderous affair and its positioning in response to the condition of the sea has to be prompt, smooth, and positive. To do this job, the marine engineers developed a hydraulic servo system and a Gerotor pump was selected to work with the sensing elements to provide control power to the main actuator. Other applications of a similar nature have been made in the steering systems of battleships and other heavy vessels and the positioning of hydraulic pistons in other types of service. Our experience in servo work of this type is yours for the asking.

Fig. 1. Multiple element pump

Important advantages are offered by the Gerotor pump for servo control applications. It is a positive displacement pump and provides a smooth power flow from one end of the pumping cycle to the other. Unlike other types of pumps which tend to quit work at the low end of the speed range, *Gerotors stay right on the job and provide positive power to the extremely low range.* Thus, they are exceptionally responsive in servo systems.

The Gerotor pump is a form of internal gear pump—simple and compact in basic design, (has only two moving parts). It is lightweight, valveless, provides exceptional performance and has low wear over a long service life. In addition it is balanced and extremely quiet in operation.

Common applications for Gerotor pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar installations.

Technical information plus complete custom engineering and precision manufacturing facilities are available to help you obtain the *right* pump to meet your performance specifications, operational requirements, envelope configuration and optimum plumbing. Your inquiry is invited.

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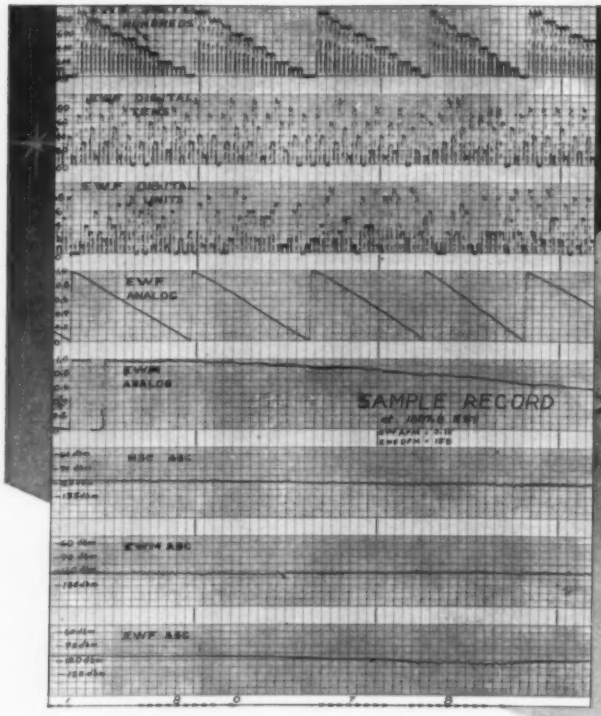

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Radio tracking of IGY earth satellites poses some of the most difficult problems — and is one of the more elaborate phases — of the entire satellite program. The Minitrack tracking system, developed by the U. S. Naval Research Laboratory, receives the satellite's signals and converts them for recording on 8-channel Sanborn oscillographic recording systems.

At each of ten stations in the Minitrack chain, two 8-channel Model 158-5475 Sanborn systems with 150-2900VA Dual Channel DC Amplifiers record the data. Of the 16 Minitrack variables fed to the Sanborn systems, five are timing information and tracking system performance data, the remaining 11 relating to the satellite's position. Voltage analogs developed from phase angles of 5 signals will determine position. Since the analogs vary from 0-60 volts at rates up to 120 volts per second, with flyback from full scale to zero in less than 1 millisecond, the high linearity of the Sanborn recording systems becomes extremely important. Six more "position" channels will be used for digital recording — three for an "east-west" antenna pair, three for a "north-south" antenna pair. Because these recordings must be clearly readable to 1 part in 1000, each of the three channels will record tenths, hundredths and thousandths individually as shown in the actual digital recording of signals of the satellite transmitter carried in an airplane. To insure clean, easily read records, the Sanborn systems must record signals varying from 0 to 0.9 of full scale in a few milliseconds and recover from the transient in less than 15 milliseconds. The trace in the margin of the recording is serial coded timing information.

Ask Sanborn for specific recommendations on your oscillographic recording problems. Short form folder, or complete 16 page catalog, available on request.

INDUSTRIAL DIVISION
SANBORN COMPANY
175 WYMAN STREET, WALTHAM 54, MASS.

. . . recording the answers to industrial design, production and field testing problems

Flexible Sanborn "150" systems with interchangeable plug-in Preamplifiers are solving countless measurement and recording problems in industry. Basic advantages of these systems include clear, inkless recordings in true rectangular coordinates; 1% linearity; choice of 13 front ends including 11 plug-in Preamps; single to 8-channel systems; console or separate case housing. For analog computer readout, extensive use is made of Sanborn "150" systems equipped with Dual-Channel DC Amplifiers (as used in the Minitrack equipment), and the compact new 6- and 8-channel "5490" and "5495" mobile console systems with the 183 Programmer for automatic control of various sequences.

51,000 hours and 3,000,000 miles
WITHOUT AN ENGINE FAILURE

...that's the extraordinary record of Franklin engines in Bell helicopters operated by Chicago Helicopter Airways

Chicago Helicopter Airways has flown Franklin-powered Bell helicopters for 10 years in its pioneer helicopter air mail service in amassing this dramatic proof of Franklin engine reliability. These flights have carried more than 24,000,000 pounds of mail. 96% of all scheduled flights have been completed. There has not been a single accident during the entire period. Over the years, precautionary landings have been made, but there has never been a case of complete loss of power.

Such phenomenal reliability is perhaps the greatest single reason why *Franklin has built more helicopter engines, by far, than all other makes combined.*

Franklin

Aircooled Motors

AIRCOOLED MOTORS, INC.
SYRACUSE, N. Y.

op′ por·tu′ ni·ty

KEY OPENINGS IN 4 ADVANCED ENGINEERING AREAS AT VOUGHT

ADVANCED WEAPONS ENGINEERING

This Vought division is planning, analyzing and proposing new concepts in missile and fighter weapon systems. Here, tactical requirements are established for new weapons, feasibilty studies conducted, and proposals prepared.

Select openings exist in both the Advanced Missile Technical Group and the Advanced Aircraft Technical Group. These are responsible positions for engineering specialists and for design engineers up through lead level. Following are requirements for 5 openings which are typical of others in these groups:

Electro-mechanical Systems Analyst. Aeronautical, Electrical, or Mechanical Engineer (advanced degree preferred) with 8 to 10 years experience in analytical design of guidance controls, flight mechanics, dynamics, or comparative applications of applied math. To study advanced weapon systems for guidance, controls, autopilots.

Radar System Engineer or Specialist. Aeronautical or Electrical Engineer (M.S. preferred) with at least 7 years experience in systems and/or design for radar and fire control. To make high-level studies of advanced guidance and control systems.

Advanced Weapons Staff Engineer. Ph.D. preferred, with at least 10 years background in guidance or navigation and control systems. To develop completely new concepts in guidance, navigation, or control systems.

Electro-mechanical Systems Engineer or Specialist. Aeronautical, Electrical or Mechanical Engineer (advanced degree preferred) with at least 7 years experience in autopilot, flight control, stability systems and inertial guidance systems and design work. To make high-level technical studies of various control and stabilization systems for advanced weapons.

Advanced Weapons Engineer. Aeronautical, Electrical, or Mechanical Engineer (M.S. desirable) able to develop methods for dynamic stability and stabilization studies. To join in, or direct, studies in stabilization, dynamic stability, missile and airframe configurations, and to make flight path and trajectory analyses. All in supersonic and hypersonic range.

AERODYNAMICS

Some of Vought's most vital and interesting problems are in general aerodynamics and automatic flight controls for hypersonic weapons. This work involves trajectory and configuration analyses, autopilot studies, control system synthesis and other responsible investigations. Helpful in a number of areas are Vought's low- and high-speed wind tunnels with a speed range from Mach .05 to 5.0.

A limited number of additional specialists may find assignments to match their skills in Vought's aerodynamics activities. These men may have general aerodynamics experience, or a good background in automatic flight control systems. Illustrative of openings available are these 3 posts:

Autopilot Engineer. Aeronautical, Electrical, or Mechanical Engineer (M.S. desirable) plus at least 3 years experience in stabilization, or autopilot and servomechanism analysis and design. To assist in, or direct, autopilot studies and designs for supersonic airplanes and missiles.

Aerodynamic Field Engineer. Aeronautical or Electrical Engineer (M.S. preferred) with at least 2 years experience in stability and control of high-performance aircraft. To plan and follow flight test programs of supersonic missiles from a stability and control standpoint, and to extract aerodynamic derivatives from flight records.

Aerodynamics Engineer. Aerodynamics Engineer with Aeronautical degree or equivalent and at least 3 years experience. To work on supersonic aircraft and missiles in aerodynamic analyses of performance, air loads, stability and control, or fluid mechanics.

STRUCTURES

Structures work at Vought is an interesting combination of research, analysis, design and test — a mixture of practical and theoretical problems. Model tests in wind tunnel and on rocket sleds, together with high-speed digital computation are used extensively for stress, flutter analysis, and dynamic response calculations.

At lead and staff levels in this activity, a few positions of responsibility are open. Especially attractive to men with solid backgrounds in applied mechanics or mathematics, or to men with wide knowledge of structural aircraft elements, are these 3 immediate openings:

Engineering Specialist, or Staff Engineer. With Ph.D. in applied mechanics, plus 10 to 12 years experience in dynamic analysis or similar work with emphasis on theory application. Especially desire applied math background with good engineering experience. To consult on dynamic testing, flutter and vibration and, possibly, on aeroelasticity.

Lead Dynamics Structures Engineer. Mechanical, Aeronautical, or Civil Engineer with M.S., or B.S. in Engineering with an M.S. in Math. Also, 5 to 7 years experience in dynamics and analysis, flutter and vibration, aeroelasticity and missile launching systems, structures design and testing. To direct small group of engineers in dynamic, flutter and vibration tests, and in stress analysis work.

Lead Structures Test Engineer. Engineer (M.S. preferred) with 5 years experience in structures or related field covering power controls, hydraulics or hydraulic systems, and control systems. To direct groups of engineers in work on structural aircraft elements, components and complete aircraft, including test work and report writing.

PROPULSION

Vought is studying a number of advanced propulsion systems. They include nuclear, solid and liquid fueled rocket components. They involve intensive investigations into internal aerodynamics, heat transfer and other problems.

Additional skilled theoreticians and engineers are needed to advance these studies. For a few men whose skills have been highly developed — academically, or on the job — these openings offer pioneering experiences with an outstanding weapon systems management team. Requirements follow for 4 of these posts:

Aero or Thermo Specialist. Aeronautical or Mechanical Engineer with advanced degree plus at least 7 years in propulsion system design, specializing in internal aerodynamics and heat transfer. Special consideration for Mach 4 and above flow study experience. To lead complete studies in this specialty as applied to new propulsion systems.

Lead Propulsion Engineer. Aeronautical or Mechanical Engineer with advanced degree, plus 1 to 4 years experience in nuclear, solid and liquid rocket, or ramjet design. To develop new propulsion systems using nuclear and/or rocket fuel components (solid and liquid). To carry design through preliminary stages and possibly assist project phases.

Staff Engineer, Nuclear Propulsion. Aeronautical or Mechanical Engineer, or Physicist with M.S., plus 10 years experience in propulsion system design, including 5 in nuclear development. Should be equipped to perform all technical design work in connection with nuclear propulsion systems.

Propellant Analyst. Chemical Engineer with M.S. (preferred) or B.S., plus 5 years experience in solid and/or liquid fuel studies. To develop propellants for unique power systems.

To arrange for a personal interview, or for a prompt report on these or other current openings, return coupon to:

C. A. Besio
Supervisor, Engineering Personnel
CHANCE VOUGHT AIRCRAFT,
Dept. M-2
Dallas, Texas

I am a _____ Engineer,

interested in the opening for _____.

Name _____

Address _____

City _____ State _____

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

Vought Vocabulary

e·con′o·my: *when round-trip missiles save taxpayers $102,950,000*

Most missiles land head-first – and, like a bomb, just once. This destruction is desired in a missile strike, but it makes development costly. Scores of missiles often are expended before development problems are solved.

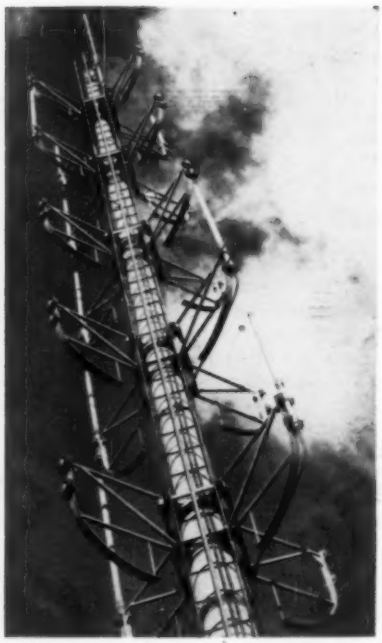
Vought's *Regulus I* and *II* reduce this expense by their dual application. Tactical versions of these guided missiles can strike head-on, with a devastating nuclear wallop. Test and training versions, used in development, can be recovered to fly again.

One *Regulus* was flown and recovered *18 times*... another made 16 successful flights. Six hundred recoveries of both missiles have saved $102,950,000 and gained an inestimable quantity of technical data.

Regulus I has armed submarines, cruisers and carriers with a nuclear punch since 1955. *Regulus II*, with a range of more than 1,000 miles and able to exceed twice the speed of sound, will join the Navy's underwater and surface Nuclear Fleet.

Scientists and engineers: pioneer with Vought in new missile, manned aircraft, and electronics programs. For details on select openings write to: C. A. Besio, Supervisor, Engineering Personnel, Dept. M-2.

CHANCE VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS



AIR-GROUND public radiotelephone, now undergoing evaluation in Midwest, enables airborne passenger to place or receive calls to or from almost any telephone in the world. Base station antenna (right), located in Chicago, links airplane with . . .

Airborne Telephone Arouses Enthusiasm

By Philip J. Klass

Milwaukee—Public air-ground telephone service, which enables an airborne businessman or airline passenger to place and receive telephone calls to and from almost any spot on Earth, is generating enthusiasm among users participating in evaluation tests.

If the Federal Communications Commission finds it possible to allocate the necessary channels in an already congested radio spectrum, it seems certain that most airliners and business aircraft will be equipped so that their passengers can place and receive telephone calls in the air as quickly and easily as in their homes or offices.

Total weight of the airborne equipment developed here by AC Spark Plug is less than 40 lb., including transmitter-receiver, handset, selective calling and antenna.

Although AC has not set any prices, equipment cost is expected to be quite modest.

Public air-ground telephone service is undergoing evaluation tests in a limited midwest area which includes major portions of Illinois, Wisconsin, Indiana, Michigan and Ohio under a one-year trial authorization by FCC. All air-ground contacts are made to one of two base stations. One, located in Chicago, is operated by Illinois Bell Telephone Co.; the other, in Detroit, is operated by Michigan Bell (AW Sept. 23, p. 41). Because the air-ground radio operates in the ultra high frequency (UHF) band, service presently is available only to equipped aircraft flying within line-of-sight range of one of these base stations.

Speedy Service

Placing a telephone call from aloft is hardly more involved than making a conventional long-distance phone call. The charge usually is only slightly more than for a conventional call. Telephone call from an airplane can be made "collect" or charged to the aircraft's owner; calls originating on the ground cannot be made "collect."

Airborne passenger lifts the familiar telephone handset off its hook, depresses a button on the handset handle for a couple of seconds (to "alert" base station operator), then releases it. Almost immediately a female voice announces: "This is Chicago (or Detroit) Aviation Service."

Speaking at a normal telephone volume level, airborne passenger then identifies his aircraft by its assigned call number, indicates airplane's approximate position, gives name, city and phone number of party he wishes to talk to. Usually within a matter of 10-15 sec. the call is completed, barring busy telephone circuits or other situations encountered in ordinary telephone service.

Calls originating on the ground for passengers aboard an equipped airplane can be made as quickly, providing airplane is flying within line-of-sight range of one of the two existing base stations.

Party on the ground merely asks long-distance operator for Chicago or Detroit Aviation Services, gives the call number of the aircraft or otherwise identifies it. Base station operator then uses selective calling system which flashes a light and sounds a chime or buzzer in the airplane being called.

Only significant difference in procedures between air-ground telephone and regular telephone service is that the airborne passenger must press handset button before talking, release it to listen. However, this technique is quickly mastered and could be eliminated, if desired, by increasing equipment complexity and cost, according to Arthur Runft, head of AC's Commercial Electronics Department.

Evaluation Installation

Total of 18 AC Spark Plug airborne equipments have been installed for the one-year evaluation tests. This includes one on a Northwest Airlines Stratocruiser, another on a United Air Lines executive Convair 340, another aboard a Civil Aeronautics Administration airplane. Remainder are on business or corporate aircraft, including a Cessna 310 operated by Gran-Aire of Milwaukee in charter service.

In the several months that service has

AVIATION SERVICE operators on the ground who take call, make connections via regular Bell System land lines to other party either on ground or in similarly equipped airplane.

been in operation it has been put to a number of uses. For example:

• **Ground Control Approach (GCA)** into Chicago Midway Airport, simulating failure of airplane's normal two-way air-ground radio, made use of public air-ground telephone connected directly into GCA controller's room to receive talk-down instructions.

• **Air ambulance service,** carrying seriously ill passenger to Appleton, Wisc., was able to telephone ahead to hospital and arrange for ambulance to meet airplane at airport. Al Goodman, Gran-Aire vice president and chief pilot, told AVIATION WEEK he also uses air-ground telephone to arrange ground transportation and for other special needs of his charter passengers.

• **Up-to-the-minute weather reports** have been obtained by pilots by telephoning directly to Weather Bureau forecasters when they encountered unexpected bad weather conditions.

• **International telephone call** from Brazil to corporation executive's office was made while executive was en route to Chicago in a company airplane equipped by AC Spark Plug. Call was quickly transferred and completed between airborne executive and a business associate located thousands of miles away on another continent.

Inflight Demonstration

AVIATION WEEK's reporter was given a demonstration of the new air-ground telephone service in a Gran-Aire Cessna 310. Flying 7,500 ft. over southern Wisconsin, reporter placed and completed calls to New York and Washington as quickly as is customary for normal point-to-point calls. One call, to Cedar Rapids, Iowa, encountered a busy circuit. Within a couple of minutes a flashing light and chime indicated the aircraft was being called by the Chicago base station. When the handset was removed from its hook, the party was on the line.

Quality of transmission and reception is excellent, comparable to regular point-to-point telephone service. Noise-canceling microphone used in the handset, made by Roanwell Corp., effectively removes all engine noise from the airborne transmission. Flying at 7,500 ft., radio-telephone contact was maintained at distances beyond approximately 160 mi. away from the Chicago base station whose antenna is located at a height of 540 ft. atop the Field Building. Detroit station antenna is located in an open field on edge of the city at a 50 ft. height.

User Reactions

To evaluate equipment performance and usefulness of the new service, AC Spark Plug has asked users participating in service test to fill out a small form each time a call is placed or received. Information requested includes approximate airplane location, altitude, weather conditions, how long it took to place the call, whether it was completed successfully, quality of the transmission and similar details.

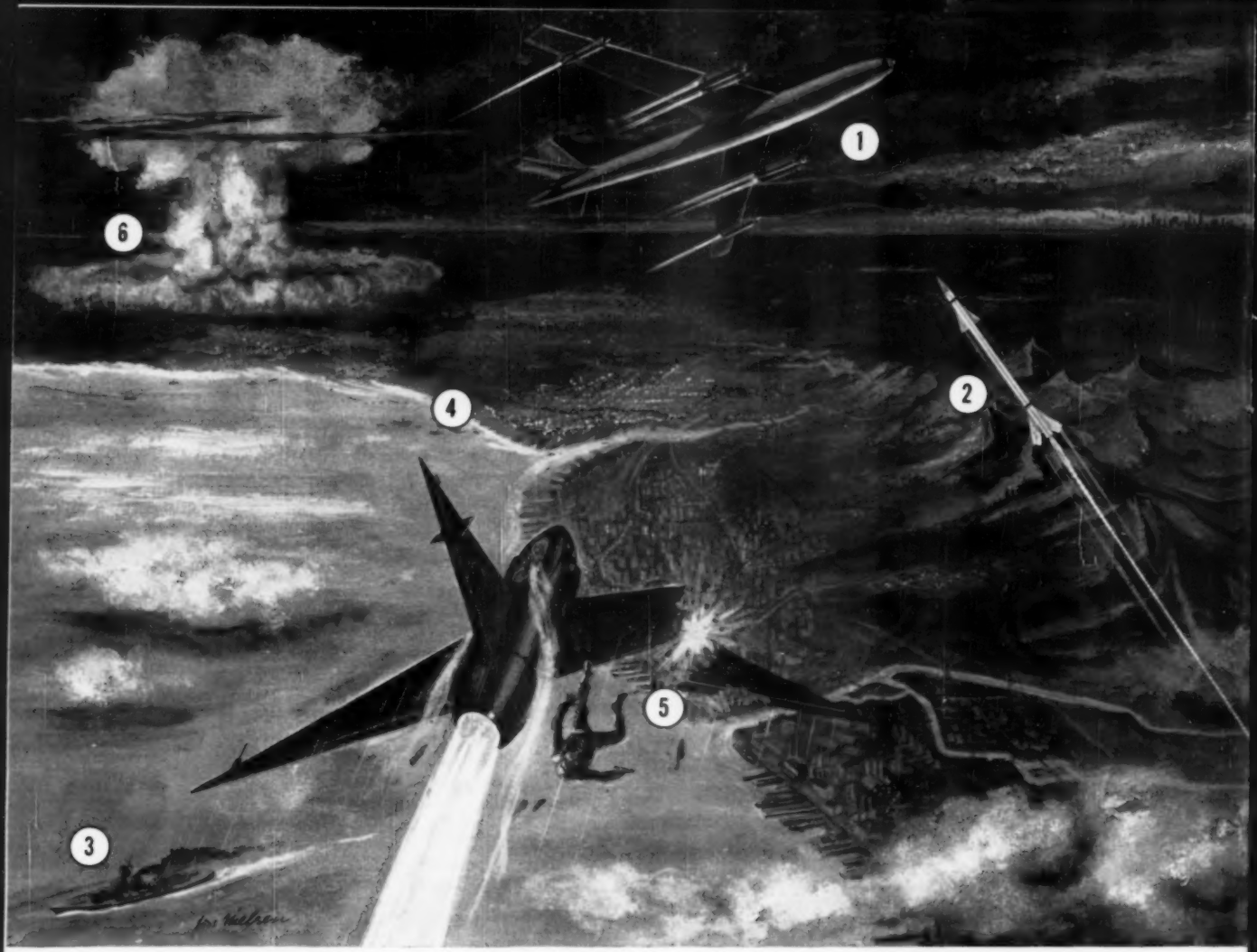
AVIATION WEEK scanned through more than a hundred such reports, found them to be almost universal in their praise of both equipment performance and the new service. One representative comment: "A new high in communications. Very clear, no work to talk or hear." Almost without exception, ground contact was established within a few seconds, providing aircraft was within range of a base station. (If service is authorized by FCC, American Telephone & Telegraph Co. plans to set up a nationwide network of base stations.)

AC Spark Plug has received numerous requests for the loan of additional airborne equipments, according to Runft. However, company has no immediate plans to build additional units pending clarification of the prospects of future frequency allocations for the service.

Choice of FM

New ground and airborne equipments employ frequency modulation (FM), following recommendations made by Radio Technical Commission

AIRBORNE radiotelephone, developed by AC Spark Plug, weighs only 40 lb. including handset and selective calling, antenna and FM transmitter-receiver in ½-ATR-size case.



DEATH in the Atmosphere!

Infrared Systems, Developed by SERVO,
Put Super-Sensing in Defensive and Reconnaissance Weapons Systems

Is it a missile-killer, screaming up with its infrared terminal guidance fixed unerringly on the invading jet or rocket? Or is it a BAS (Battle Area Surveillance) drone, using infrared to relay to command headquarters the revealing live picture, *day or night,* of enemy disposition, actions, and concentrations? Or is it fire control against opposition surface forces—land or sea—based on the sure, unshakable direction of infrared sensing?

Infrared intelligence is the fast growing key factor in the most effective use of modern weapons systems . . . and Servo Corporation of America has produced *more infrared systems for military use* than anyone else in the world.

Servo Corporation is equally outstanding in the development and production of ground support systems. Its exclusive electronics equipment for use in designing, building, testing, and control of missile systems is without challenge. Also setting new standards of performance in their fields are the SERVOFLIGHT UHF and VHF Quasi-Doppler Direction Finders for tactical air traffic control and electronic intelligence.

1. IR Reconnaissance
2. IR Missile Guidance
3. Anti-Submarine Warfare
4. Battle Area Surveillance
5. IR Fire Control
6. IR Bombing System

And Servo Corporation's exclusive airborne DRT (Dead Reckoning Tracer) has no equal, anywhere. Aboard the Navy's AEW picket planes, it traces out the position and direction of the aircraft at every moment during its flight. A light-weight version which includes automatic navigation features is being produced for the Air Force.

For full information on infrared systems, either components *or* complete weapons systems, and on how Servo Corporation's talents, experience, and capacities can assist in problems related to infrared, electronics, optics, and related fields—please call, wire, or write:

SERVO CORPORATION OF AMERICA
20-20 Jericho Turnpike New Hyde Park, L. I., N. Y.

DETROIT base station antenna, located on city outskirts, is 50 ft. high.

for Aeronautics (RTCA) special committee No. 78 in its report 128-57/EC-322, and specifications prepared by Aeronautical Radio Inc.

Major reason for selecting FM over amplitude modulation (AM) is its "capture effect" which effectively locks an FM receiver to a transmitter despite another transmitter operating at same frequency within line-of-sight range. This lower susceptibility of FM to co-channel interference permits the use of fewer channels, hence less radio spectrum. It is estimated that 40 to 60 channels can handle aviation's air-ground telephone needs for the next 10-15 yr.

Another advantage of FM is its relative freedom from static, propeller modulation and other adverse propagation effects.

Equipment Details

AC Spark Plug's airborne equipment, designed for operating in the 450-470 mc. band, consists of a 20 w. transmitter and a triple-superhet receiver with a one microvolt sensitivity. Both transmitter and receiver are fixed-tuned. They are housed in a ½-ATR-size case which weighs 27 lb. including a small inverter.

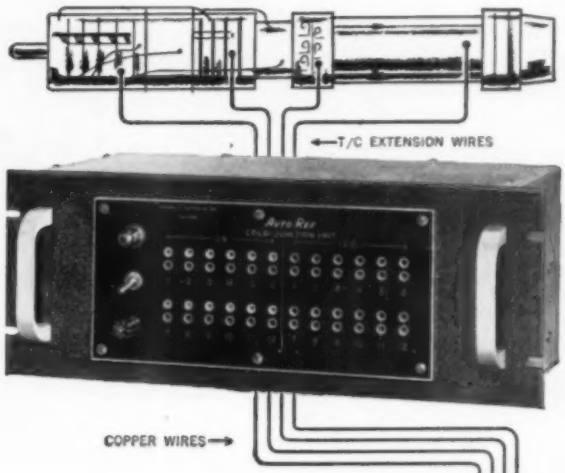
For present service tests, all 18 equipments are being operated on the same 454.95 and 459.95 mc. frequencies, one used for ground-to-air transmissions and the other for air-to-ground.

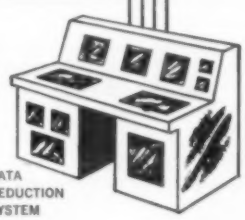
However, in any full-scale implementation, each airplane transmitter-receiver would be pretuned to one pair of frequencies, among the 40 to 60 available. To hold down airborne equipment cost and complexity and to simplify airborne procedures, ground stations would be equipped with receiver which scans the assigned spectrum, detects a call from any equipped airplane, then automati-

T-E's *AUTOREF*® Provides

Cold Junction Compensation For Many Thermocouples

Ideal For Data Reduction Systems





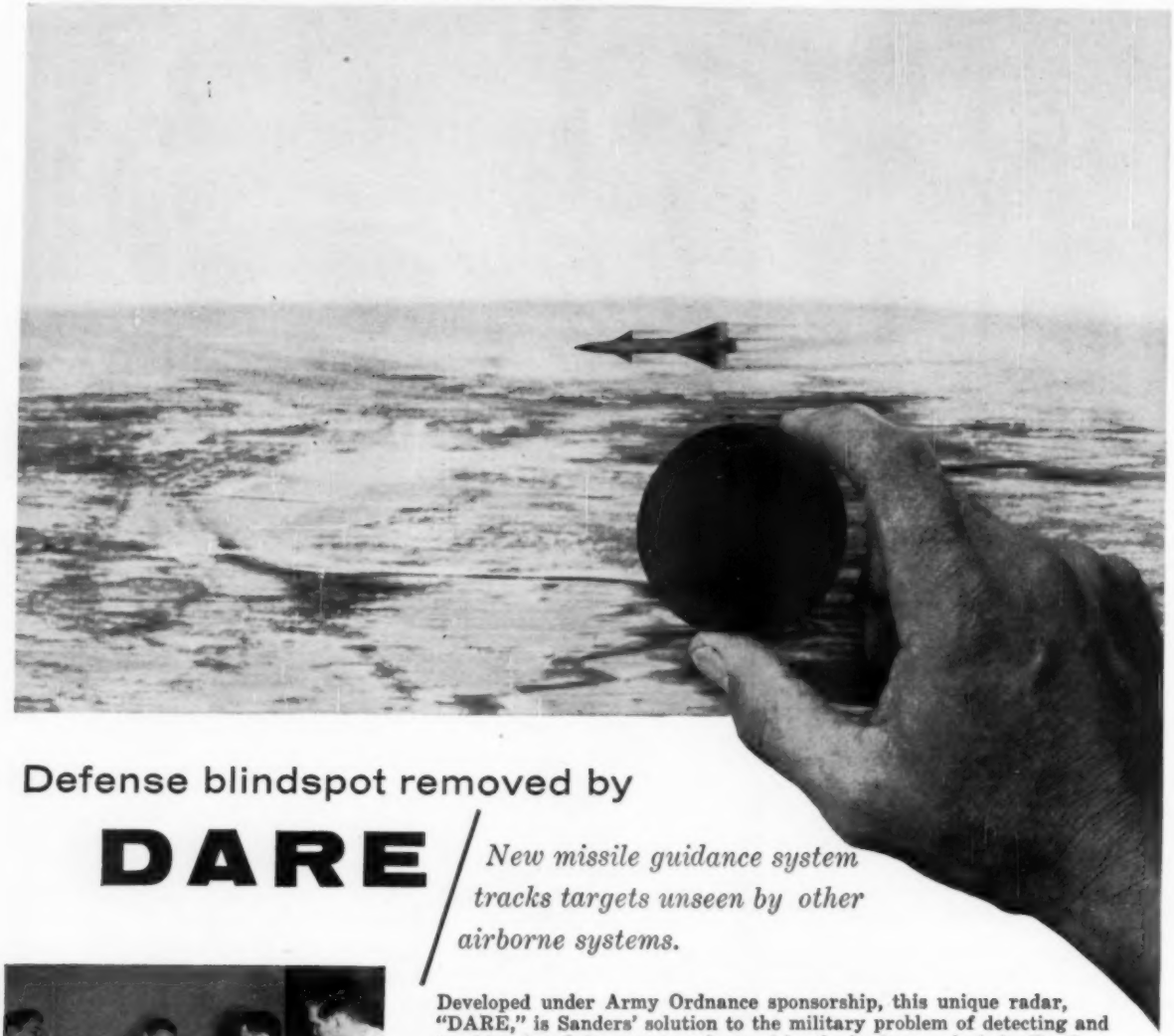
For any test cell work where temperatures and other D.C. signals must be recorded together – as on multi-point recorders or data reduction systems –T-E's "AutoRef" provides fast, accurate cold-junction compensation for the thermocouple circuits. In one, compact unit it gives you constant, pre-determined, cold-junction reference for many thermocouples – actually up to several hundred. Typically, cold-junction temperatures can be controlled to within ±1°F. over a wide range of ambient temperatures.

Besides its accuracy, the "AutoRef" offers tremendous convenience – saving both time and effort. Designed for panel rack mounting, it can be introduced anywhere in the thermocouple circuit – no matter where thermocouples and instruments are located. Whenever temperatures, pressures, flow-rates and other electrical and mechanical conditions are being recorded simultaneously, the "AutoRef" does away with the need for maintaining ice baths or making laborious correlations. It is available for all standard thermocouple calibrations.

Write for Bulletin 81-C

Thermo Electric Co., Inc.
SADDLE BROOK, NEW JERSEY
In Canada — THERMO ELECTRIC (Canada) Ltd., Brampton, Ontario

Another example of SYSTEMS CAPABILITY *at Sanders Associates*



Defense blindspot removed by

DARE

New missile guidance system tracks targets unseen by other airborne systems.

SANDERS' "DARE" TEAM was headed by William Morgan, Coherent Ground System; Kenneth Dollinger, System Project Engineer; Alfred Cann, Missile Seeker; Robert Stetson, High Voltage and Microwave Circuits.

500,000 SQUARE FEET OF FLOOR SPACE give Sanders Associates ample room for expanded research, development and production of electronic, electromechanical and hydraulic components, sub-assemblies and systems . . . in interchangeable modular designs or subminiature packages.

Developed under Army Ordnance sponsorship, this unique radar, "DARE," is Sanders' solution to the military problem of detecting and tracking low-flying targets obscured by the background of the Earth.

DARE exploits Sanders' capabilities in both systems and components. The same personnel who speeded this system through study and demonstration stages have contributed successive significant "breakthroughs" in missile and radar developments since 1945.

Design and production of key missile components has enhanced and assured success of the DARE project. Sanders Associates is a well-known creator and producer of *hydraulic servos* for steering and controlling missiles and antennas . . . *rate gyros* for stabilization and control . . . *microwave components* for antenna and RF circuitry . . . *flexible printed circuitry* for decreasing size and weight and increasing system reliability.

Systems capability at Sanders extends in many directions. Research, development and production experience and facilities are geared to accelerated progress in anti-submarine warfare, fire control, electronic countermeasures, autopilot and industrial automation systems. Sanders Associates can find answers to your systems problems, too.

SANDERS ASSOCIATES, INC.

NASHUA, NEW HAMPSHIRE • *Inglewood, California* • *Washington, D.C.*

SINGLE antenna serves both transmitter and receiver in duplex operating mode.

cally tunes ground station receiver and transmitter to that airplane's assigned frequency.

If 40 to 60 pairs of channels must be divided among several thousand airline and business aircraft, it is obvious that 25 or more aircraft will share the same pair of channels. If two such aircraft flying near the same base station both seek to place a call simultaneously, one of them would have to wait. To avoid this situation, AC has designed two pairs of channels into its airborne equipment so that if one "circuit' is in use, the aircraft can switch to the second.

Existing Service

Radiotelephone service operating in the 2,000 kc. band, originally set up for ship-to-shore communications, is being used today by an estimated 600 aircraft. However, there are relatively few channels and this can result in a 30-45 min. delay in obtaining an available circuit.

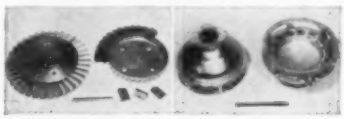
This is no problem for a slow-moving maritime vessel but a fast-moving airplane can be out of range of the coastal station before its call is completed. Furthermore, the relatively low frequency band of this ship-to-shore radiotelephone is susceptible to diurnal noise and propagation variations.

The fact that some 600 aircraft are equipped with this service despite these limitations is an indication that the potential market for the proposed new air-ground aviation telephone service should number in the thousands of users.

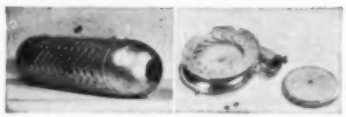
Military Role Linked To Avionic Reliability

Washington—Change in military practices as well as industry action is needed if reliability of avionic equipment is to be improved, an official of Hughes Aircraft Co. warned here at

The 72-inch dia. hydrogen atmosphere furnace being lowered over a loaded furnace bell. Detroit plant.



Brazed stainless steel and titanium alloy parts are strong, undistorted, and bright and free of oxides.



If you are planning the manufacture of stainless alloy assemblies, you should check our facilities and skills for

BRAZING and PROCESSING

Stainless Steel & Titanium

You'll find our up-to-the minute facilities and years of experience can help you in your stainless steel brazing and heat treating. All three of our plants are equipped with pure dry hydrogen atmosphere furnaces, and are manned by skilled engineers. They are also pioneers in the use of Nicrobraz, the stainless brazing alloys that have the strength and corrosion resistance of stainless steel at 2000° F.

Vacuum-type furnaces are used in the Detroit plant for silver brazing complex titanium alloy assemblies. Our fluxless process provides high joint shear strength with no distortion, oxidation, or loss of ductility. Heat treating and degassing of titanium alloy parts is also done. Contact us for more information.

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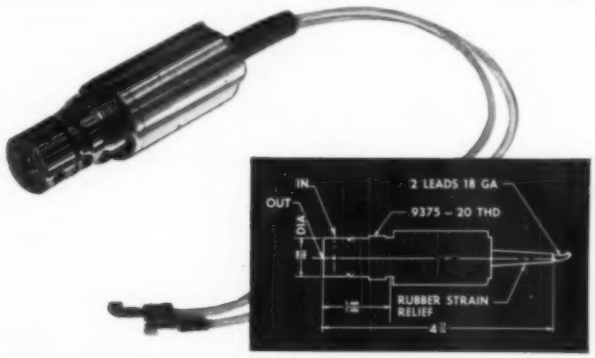

Proven Valve Performance

. . . is behind the development and precision production of this K-W high pressure air or hydraulic solenoid valve. Only minimum mounting space is required for this valve whose two closely spaced annular ports are seperated by face sealed "O" rings. Operating up to 3000 psi. at 17 to 30 volts DC in a -65° to 165° F. ambient range, this is but one of many valve and solenoid applications developed by Koontz-Wagner for the aviation industry. If your problems include the need for design and production of specialized electro-mechanical devices, write:

MANUFACTURING DIVISION
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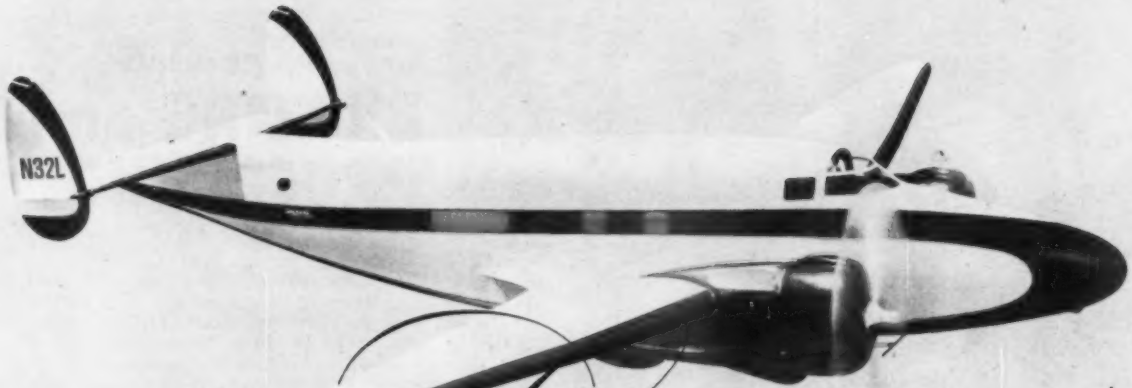

Learstars

fly the polar route...
No other business aircraft can!

On November 10, 1957, a standard twin-engine production model LEARSTAR was flown from PacAero's assembly line in Santa Monica, California, over the Frobisher polar route for delivery in Dusseldorf, Germany. One stop for refueling was made. No special equipment, no auxiliary fuel tanks were carried. This 22 hour, 58 minute polar flight is typical of LEARSTAR safety, performance and ability—approached by no other business aircraft and matched by only three commercial airliners.

LEARSTAR is the only business aircraft in its class licensed in AIRLINE TRANSPORT CATEGORY CAR 4b.

PACAERO ENGINEERING CORP. PacAero

A Subsidiary of Pacific Airmotive Corporation

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the recent National Symposium on Reliability and Quality Control.

William W. Wooldridge, Hughes vice president and assistant general manager, cautioned that "some realistic thinking is essential on the trade-off between performance and reliability." He also called for an expanded government-sponsored research program in component development. In the past it has been "very difficult" to get money for component research and development until a definite equipment application is in sight, Wooldridge said. "This is too late."

The Hughes official complained that manufacturers have a hard time getting government support for reliability improvement programs, despite the acknowledged net saving in military maintenance costs which would result. However, Wooldridge cautioned against the other extreme—reliability programs conducted without regard for cost.

Equipment reliability must compete for management attention with such other factors as schedule, performance and cost. Until recently it has been difficult to express reliability in the quantitative terms in which schedules, performance and cost can be measured which explains, Wooldridge said, why it has not gotten the same management attention as the other three factors.

Speaking of the new Defense Department program to introduce reliability specifications and tests into new equipment contracts, Wooldridge said it remains to be seen whether such tests can provide results which are representative of reliability in actual service use.

"A prudent management," Wooldridge said, "will take a hard look at the degree of business risk involved in reliability specifications. There is the very real danger that too much money and manpower will be tied up in demonstrations to the detriment of the real job, which is to improve equipment." With experience, however, Wooldridge said he believes that reliability will become another factor which management can measure and control.

In-service reliability of equipment is at least partially beyond the control of the manufacturer, according to Wooldridge. He reported that data from service operations shows that differences in reliability experienced by different user groups is "many times more variable than can be accounted for by differences in the equipment itself."

Expansions, Changes In Avionics Industry

Radio Corporation of America and Allis-Chalmers Manufacturing Co. have set up an engineering staff group, known as C Stellarator Associates, to design and build a facility at Princeton University for advanced research into controlled thermonuclear reactions. The Model C Stellarator, to be located at Princeton's James Forrestal Research Center, is slated for completion in 1960.

Other recently announced expansions, mergers and changes in the avionics field include:

• **Controls Company of America** has contracted to acquire **Hetherington, Inc.**, maker of avionic switches, through a stock exchange.

• **Quan-Tech Laboratories** is name of new company which will produce electronic instruments, power supplies and special purpose amplifiers. John M. van Beuren is general manager. Company's address: 236 Mt. Kemble Ave., Morristown, N. J.

• **General Precision Laboratory** has opened new 22,000 sq. ft. engineering building, its third major addition in the past two years, at its Pleasantville, N. Y., headquarters.

• **Van Norman Industries, Inc.**, has formed new Electronics Division which will combine company's former Insuline and Transitron subsidiaries under single management. Samuel K. Lackoff heads new division which will continue operations in former Insuline facility in Manchester, N. H.

• **Dalmo Victor Co.**, Belmont, Calif., has formed new Electronic Systems Division which will be headed by Glenn A. Walters, company vice president.

• **Airtron Inc., Linden, N. J.**, has added 40,000 sq. ft. of floor space, bringing number of buildings now occupied to seven.

• **Lundy Manufacturing Corp.**, Glen Head, N. Y., is building 14,000 sq. ft. addition to house its recently acquired Ryan Industries Division, producer of chaff countermeasures systems.

• **Schweber Electronics** has opened new 10,000 sq. ft. building at 60 Herricks Road, Mineola, N. Y.

• **Elgin National Watch Co.** has opened new headquarters for its Electronics Division in Elgin, Ill., in 50,000 sq. ft. building.

• **Telemeter Magnetics, Inc.**, Los Angeles, has acquired the Ferro-Magnetics Production Division of International Telemeter Corp. The new acquisition will be under the direction of Milton Rosenberg.

• **Commonwealth Plastics Corp.** recently opened a new Dielectric Products Division for fabricating avionic components such as radomes, reflectors and similar reinforced plastic parts.

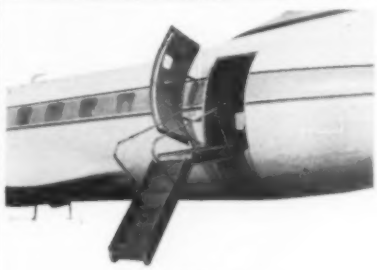
• **Thomas Wilcox Associates, Inc.**, Washington, D. C., will offer technical consulting and public relations services to rocket and missile manufacturers. Founder, T. W. Wilcox, is former Chief for Liaison and Analysis of the Air Force Office of Scientific Research.

FILTER CENTER

▶ **Ultra-Precision Resolver**—Variable-reluctance type resolver, accurate to within three seconds of arc (equal to angle subtended by a baseball at distance of three miles) has been developed by Bell Telephone Laboratories under Air Force sponsorship. Device has all windings on the stator, eliminating rotor sliprings and contacts. Models are being built by Clifton Precision Products Co.

▶ **Cloudy Crystal Ball**—Semiconductor industry sales, which totaled approximately $143 million last year, are expected to reach $200 million this year and $1 billion by 1967, according to General Electric estimates. Transistors, currently used in 12% of all electronic equipment produced, are expected to be used in over 80% of equipment produced in 1967. Some types of transistors may be selling for around 35 cents each by 1967, considerably below price of vacuum tubes, General Electric predicts.

▶ **Copper-plating for Aluminum**—Sylvania Electric has developed process for electroplating copper on aluminum strip and aluminum wire in thicknesses ranging from a flash coating to 0.002 in. per



NEW JOB for a

SATISFIED CUSTOMER

The aft-mounted retractable stairway pictured above, installed by PAC in an executive Convair 240 for long-time customer Murray Corporation of America, is a concrete example of Pacific Airmotive's expert performance in all phases of aircraft modification and maintenance.

First assembly of its kind ever built for a Convair 240, the stairway was designed, fabricated and installed by PAC in only nine weeks. Major engineering problems were successfully solved under under deadline conditions.

Corporate or airline operators with difficult or unusual problems demanding superior engineering and production skills look first to Pacific Airmotive. From Bonanzas to DC-7s, PAC's "one-stop" service means one stop at one location for any type of work on airframe, engines, propellers, accessories, radio, instruments or cabin interior, with all items coordinated to get the job out on schedule.

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First flight—ahead of schedule

707 prototype, already test-flown 3½ years, holds coast-to-coast transport record: 3 hours, 48 minutes.

On December 20, 1957, the No. 1 production model of the Boeing 707 jetliner made its first flight—a week ahead of schedule.

It is logical that America's *first* commercial jetliner, the 707, should be a Boeing. For Boeing's design and production skills, and vast modern facilities, are backed by the experience gained in building over 1600 multi-jet aircraft . . . more than any other company in the world.

It was Boeing, back in 1952, that began construction of the prototype model of the nation's first jetliner. Design advances, made possible by that prototype's three and a half years of test-flying, are incorporated in today's production models—an advantage unique to Boeing 707 and 720 jet airliners.

Early next year airlines will begin offering luxurious Boeing jetliner service on U.S. and overseas routes. When airline customers step aboard a superb Boeing 707 or 720, they'll enjoy incredibly smooth, vibration-free travel at 600 miles an hour . . . in the most thoroughly flight-tested aircraft ever to enter commercial service.

BOEING 707 and 720

These airlines already have ordered models of the Boeing family of jetliners: AIR FRANCE • AIR INDIA • AMERICAN • B.O.A.C. BRANIFF • CONTINENTAL • CUBANA • LUFTHANSA • PAN AMERICAN • QANTAS • SABENA • TWA • UNITED • VARIG

side for printed circuit applications. Copper-plated aluminum can be tinned, soldered or formed without breaking the plating, Sylvania reports. Samples are available by writing to Sylvania, 12 Second St., Warren, Pa.

▶ **Reverse Selcal**—Calsel, which enables a pilot to call a specific ground station by pushing a button in the cockpit, is undergoing evaluation tests by Pan American World Airways on route between Fiji Islands and Auckland, New Zealand. Calsel is an adaption of Selcal, also pioneered by Pan Am, which enables a ground station to call a specific aircraft. Both employ the transmission of two pair of tones over the normal high frequency radio channel. With Calsel, pilot places "call" to ground station by push button, receives a signal when ground station is ready to talk.

▶ **Dayton Avionics Convention Set**—Theme and date for the 1958 National Conference on Aeronautical Electronics, scheduled for May 12-14 in Dayton, is "Avionics, Key to Airways Modernization."

▶ **Signed on Dotted Line**—Recently announced contract awards by avionics manufacturers include:

• **Telecomputing Corporation's Brubaker Electronics** Division has received $446,484 Civil Aeronautics Administration contract for an air traffic control beacon interrogator and associated equipment for airport installation.

• **Collins Radio Co.** reports a $3.3 million order from CAA for microwave link systems to remote information from new long-range radars to Air Route Traffic Control Centers. New order brings total for such equipment to over $7 million.

• **Lear** has received production contract from Air Force for integrated cockpit display and associated gyro references to be used on Republic F-105 and Convair F-106. Lear will produce systems containing a two-axis flight director and attitude indicator, rate sensor, two gyro master reference, azimuth control, pilot's compass control panel, third-gimbal controller and amplifier.

▶ **CAA Buys New Radars**—Texas Instruments Inc. has received $4.7 million contract for 14 improved airport surveillance radars to be known as ASR-4. Radar will be able to cover area between 4,000 and 27,000 ft. at 30 mi. range, an increase of 4,000 ft. over earlier ASRs. Radar will also have built-in circular polarization to minimize precipitation clutter and improved moving target indication provisions. Each radar will provide four 16-in. scopes, one of which will serve as standby. First equipment is scheduled for installation early in 1960.

LEWIS
Selector Switches

FOR RESISTANCE THERMOMETERS AND THERMOCOUPLE THERMOMETERS

EACH SWITCH HAS "OFF" POSITION PLUS NUMBER OF POINTS LISTED.

Points	Size	Switch Part Numbers Thermocouple Type	*3 Wire Resistance-Thermometer Type
2	2"	11S2	365R2
3	2"	11S3	365R3
4	2"	11S4	365R4
5	3"	10S5	375R5
6	3"	10S6	375R6
8	3"	10S8	375R8
9	3"	10S9	375R9
10	3"	10S10	375R10
12	3"	10S12	375R12
16	3"	10S16	375R16
18	3"	10S18	375R18
20	3"	10S20	375R20
24	4"	27S24B2	385R24
28	4"	27S28B4	385R28
40	4"	38S2C	

*Resistance thermometer switches are provided with a safety resistor on off position.

2" SIZE

3" SIZE

SPECIAL SWITCHES

No. 37S6C2, Four "4 Point and OFF" thermocouple switches combined in one 3" case.

No. 9S5, Single Pole, Four Point Instrument Switch in 1¼" round case.

No. 44S4, Six Pole, Double-throw Instrument Switch in 2½" round case, one hole mounting, ½-32 threaded bushing.

DESIGNED FOR TEST WORK AS WELL AS FOR PERMANENT INSTALLATIONS. LEWIS SELECTOR SWITCHES ARE CONSTRUCTED WITH STURDY CONTACTS OF LOW RESISTANCE AND POSITIVE DETENT. THESE SWITCHES ARE SPLASHPROOF, DUSTPROOF AND ARE BUILT TO GIVE YEARS OF SERVICE.

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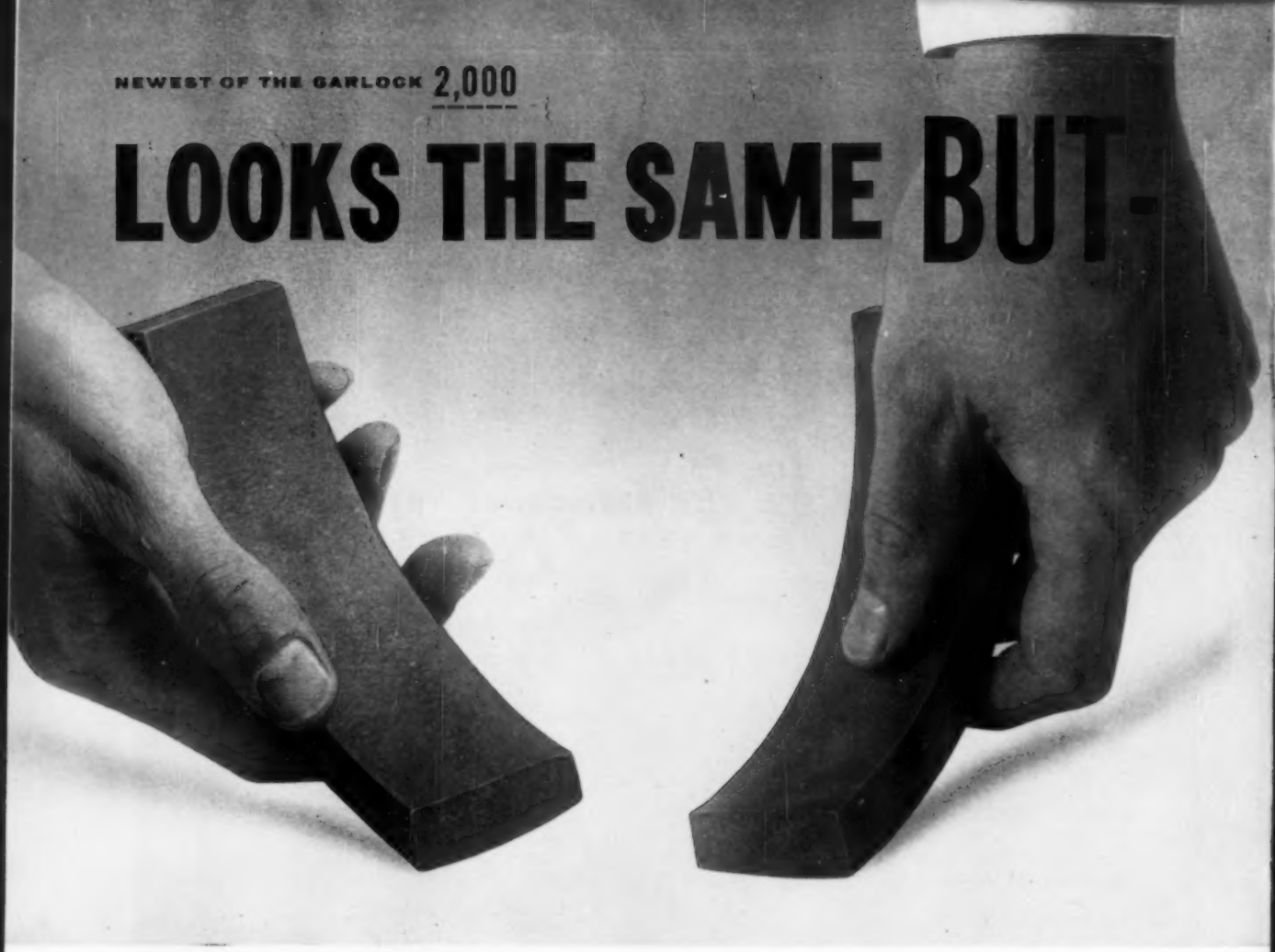

THERE'S A DIFFERENCE!

(One is Garlock's New Sponge Silicone Rubber for temperatures from —100°F to +500°F)

The hand on the right holds Garlock's latest development . . . Sponge Silicone Rubber. The other hand holds "ordinary" sponge rubber. Outwardly, they look the same, the difference is that Sponge Silicone will remain flexible at temperature extremes, sheds water, resists adhesion of ice, resists tearing or abrasion . . . in fact, Garlock Sponge Silicone Rubber is the ideal seal for around airframe openings like doors, ports, bomb bays or hoods.

Millions of non-connecting cells provide Sponge Silicone Rubber with a natural insulation which, together with the base material, make it able to withstand temperatures from —100°F to +500°F . . . and still remain flexible. Moreover, Garlock Sponge Silicone Rubber can be extruded, thick or thin, in a variety of forms with very low compression set. It's available in sheets, round and odd extruded cross sections, or simple extruded cross sections for splicing into endless rings.

New, soft Sponge Silicone is the latest of the "Garlock 2000" . . . two thousand different styles of packings, gaskets, and seals for every need. It's the only complete line. That's why you get unbiased recommendations from your Garlock representative, Call him today!

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Cross Section of Garlock Sponge Silicone Rubber shows millions of non-connecting cells which provide natural insulation as well as low temperature flexibility to —100° F. . . . heat resistance to +500° F.

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New Terminal for Nairobi

Nearly completed new airport at Nairobi, Kenya, Africa, is scheduled for March opening. Field reportedly will be equipped with all latest aids and will be able to handle modern aircraft at rate of one every three minutes.

WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Miniaturized Pulse Connectors–by J. H. Gesell, Federal Telecommunications Laboratories for Wright Air Development Center, U. S. Air Force. December, 1956: $1.25; 49pp. (PB 131-648).

A Miniature, High Altitude, Constant Cooling Capacity Blower for Electronic Equipment–by L. Cromwell, Gray and Huleguard, Inc., for Wright Air Development Center, U. S. Air Force. April, 1957: $1.25; 45pp. (PB 131184).

Protective Shot Peening of Propellers: Part 3–Fatigue and Distortion–by R. F. Broderick, Lesselles and Associates, Inc., for Wright Air Development Center, U. S. Air Force. June, 1957: $2.75; 109pp. (PB 131273).

Human Factors in the Design of Systems–by H. W. Sinaiko and E. P. Buckley, Naval Research Laboratory. August, 1957: $1.50; 52pp.; (PB 131248).

The Effects of "Task-Induced Stress" on Man-Machine System Performance–by W. D. Garvey, Naval Research Laboratory. September, 1957: $.50; 12pp.; (PB 131278).

Experiments on Vigilance One-Clock and Three-Clock Monitoring. Second in a Series–by H. J. Jerison, Wright Air Development Center, U. S. Air Force, and R. A. Wallis, Antioch College. April, 1957: $1.00. 40pp.; (PB 131191).

Structural and Vibrational Characteristics of WADC S-5 Model Propeller Blades–by J. E. Carpenter and E. M. Sullivan, Cornell Aeronautical Laboratory, Inc., for Wright Air Development Center, U. S. Air Force. June, 1957: $3.50; 131pp. (PB 131272).

Longitudinal Airplane Dynamics Wind Tunnel Test Equipment–by O. B. Tufts, G. R. Duryea, Jr., R. C. MacArthur and A. H. Zimmerman, Cornell Aeronautical Laboratory for Wright Air Development Center, U. S. Air Force. July, 1955: $4.00; 245pp. (PB 121677).

Publications Received:

Air Dates–by Air-Commodore L. G. S. Payne–Pub. Frederick A. Praeger, Inc., 15 West 47th Street, New York 36, N. Y. $7.50; 565pp.

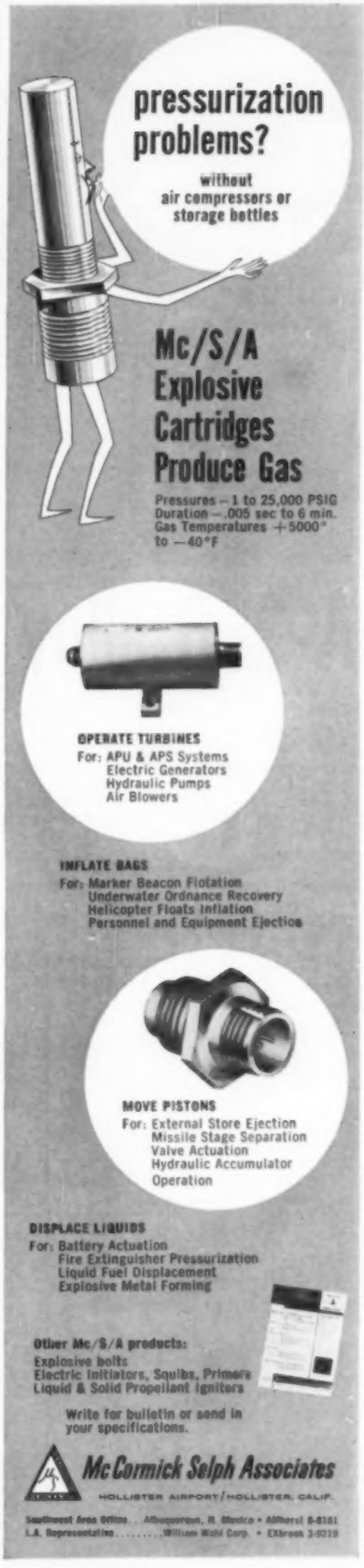
A chronological survey of the principal events in the fields of military and civil aviation, beginning 1783 and ending December, 1956.

System Engineering–by Harry H. Goode and Robert E. Machol–Pub. McGraw-Hill Book Co., 330 W. 42d Street, New York 36, N. Y. $10.00; 551pp.

This over-view of the relatively new "system design" approach to the problem of designing engineering equipment presupposes a mathematical background of elementary calculus.

Boundary Layer Effects in Aerodynamics–by National Physical Laboratory–Pub. Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. $12.00:

This book contains information of value to all engaged in aerodynamic research.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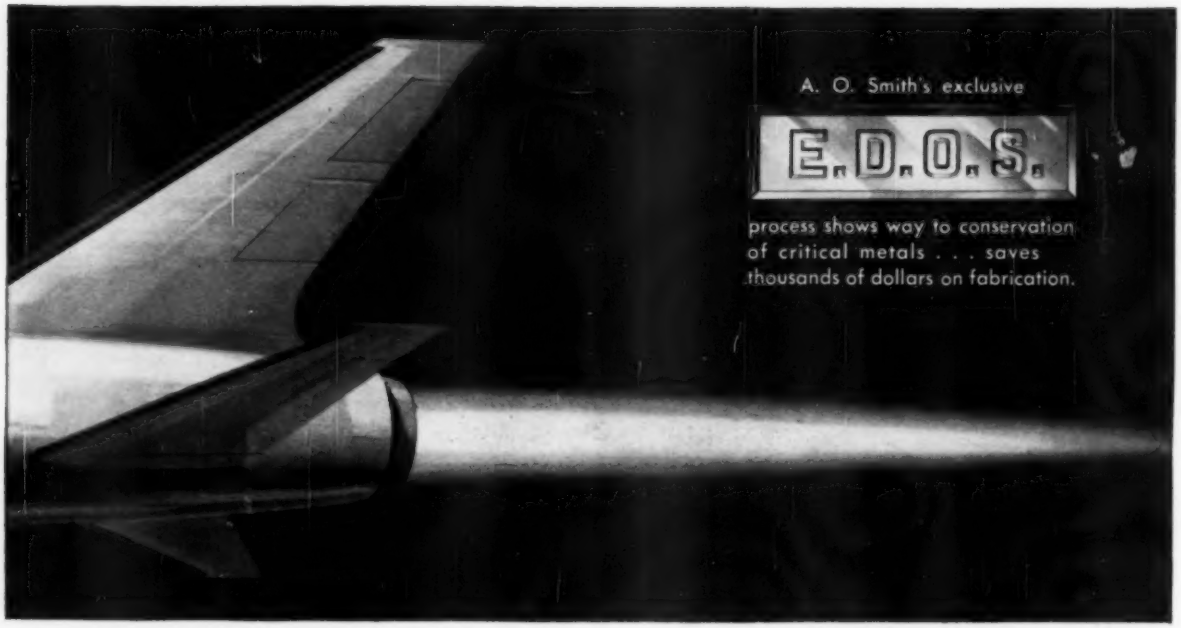
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E.D.O.S.
process shows way to conservation of critical metals . . . saves thousands of dollars on fabrication.

A-286 alloy ring for a finger of flame

Today, products are becoming increasingly complicated and costly. Further, there's mounting pressure to put them into production in the shortest possible time.

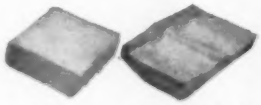
That's where E.D.O.S. (Engineered Designs for Optimum Structures) may fit into your picture — speed-wise, cost-wise.

This A. O. Smith process consists of precision forging and contour rolling followed by flash or fusion welding. With it, even the most difficult-to-work metals can be shaped . . . quickly fabricated into the parts you need with only minimum finish machining (in most cases). There's no wasted metal, no need for expensive successive machining operations to "whittle" a part down to size. Parts cost savings of up to 70% have been reported.

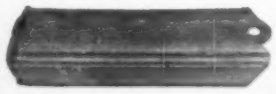
A. O. Smith's 9,000-ton, single-action, precision-forging press is the only one of its size in the country. And their 1,800-ton contour rolling mill is also the only one of its type and size in the country.

Since World War II, E.D.O.S. has helped make A. O. Smith a major supplier to the aviation, rocket, missile and related industries. A. O. Smith products are currently helping to accelerate the VANGUARD project.

E. D. O. S. applied to a jet engine case



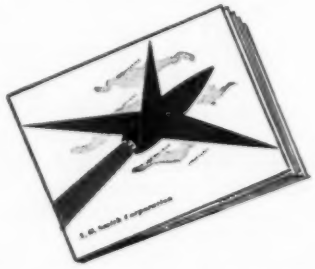
At left is one of the four high-nickel alloy blanks. At right, the same blank after pre-forging. Basic materials cost about 50% less than conventional processes.



After pre-forging, each piece is rolled and re-rolled to attain the final configuration. Piece shown has gone through initial rolling.

Then, the pre-forged and rolled blanks are formed into quadrants.

. . . and the 4 quadrants are flash-welded to form the finished part. Relatively small machining job still needed is done by the customer.



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AERO DESIGN Alti-Cruiser is a pressurized version of the Aero Commander 680 Super. Production model should be ready by end of April.

Alti-Cruiser Widens Pressurized Market

By Craig Lewis

Oklahoma City—Alti-Cruiser, currently the only American-built pressurized executive transport in production, puts Aero Design & Engineering Corp. in a favorable competitive position. Alti-Cruiser will be available in four or six seat models, will go on the market this spring.

A customer who wants a pressurized executive transport other than the Alti-Cruiser will find his choice limited to:

- **Surplus military aircraft,** which usually require extensive modification, are expensive to operate and generally are larger than the customer requires.
- **Commercial transports** such as the Convair 240 or 340 models, which generally are larger than required and are more expensive to operate.
- **Morane-Saulnier MS-760,** four-place French executive jet transport to be marketed by Beech Aircraft Corp. for a package price of $210,000 (AW Jan. 13, p. 28)—$26,250 more than the $183,750 price tag on the Alti-Cruiser.
- **New light utility transports** such as the 10-passenger turbojet Lockheed Jetstar (AW Sept. 23, p. 29) or the 10-12 passenger turboprop Grumman Gulfstream, priced at approximately $700,000 (AW Sept. 30, p. 29).

Alti-Cruiser is a pressurized version of the Aero Commander 680 Super, and pressurization will permit the airplane to make more practical use of the high altitude potential of its supercharged Lycoming engines. First production model should be ready by the end of April, and Aero Design hopes to sell 50 Alti-Cruisers this year.

New airplane was the central theme of a national meeting of the company's distributors and dealers here, where the announcement was made that a VTOL aircraft designed by Robertson Aircraft Co., an Aero Design subsidiary, has made the first flight by an aircraft of that type.

Alti-Cruiser is essentially 680 Commander with a combination pressurization, air conditioning and heating system, plus some minor modifications. Price includes an integrated communication and navigation package.

Little External Difference

Only external difference in the new airplane is the airscoop for the pressurization system in top of the fuselage and a split rear cabin window designed to accommodate a lavatory offered in the four-seat version of the Alti-Cruiser. The light twin also comes in a six-place version without the lavatory. Both are the same price.

Alti-Cruiser has exactly the same performance as the 680. Only difference is an empty weight of about 4,800 lb., compared with 4,443 lb. for the 680. Gross weight remains 7,000 lb. Exact empty weight is still undetermined since the prototype was headed for the scales when it crashed (AW Jan. 20, p. 34).

Pressurization system uses standard techniques and equipment tailored to Aero Design needs by Ted Smith, vice president research and development, and his technicians. System will provide a cabin differential of 5,000-7,000 ft., giving a 9,000 ft. cabin altitude when the airplane is at 15,000 ft.

Rate of Pressure Change

Cabin rate of pressure change is adjustable between zero and 2,000 fpm. System has a cooling capacity of 13,500 Btu. per hour and a heating capacity of 52,000 Btu. per hour with the pressurization equipment or 40,000 Btu. in ram air operation.

Air conditioning is provided on the ground when engines are running by a blower system. Switch on the main gear converts the air conditioning to ram air operation on takeoff; on the ground, the system can maintain 70 deg. cabin temperature on a 100 deg. day.

Pressurization system is powered by two engine-driven variable delivery hydraulic pumps built by Stratopower Division of New York Air Brake Co. It takes about 10 hp. of each engine to run the system. Cabin supercharger is a Stratos single stage centrifugal compressor, and the supercharger hydraulic drive motor is built by Sundstrand Aviation.

Automatic cabin pressure control equipment is an AiResearch product. And a Stratos BUR-20 turbine bootstrap cooling unit provides cabin cool-

building the structure for modern flight

High-strength steel weldments

that develop strength of more than 200,000 pounds per square inch have been developed through an intensive, four-year research program at Rohr. Present day advancements in the performance and speed of aircraft make this process vital for special components with very high load factors such as fuselage bulkheads, control brackets, wing attach fittings and engine mounts. Their manufacture demands a high level of technology and specialized manufacturing equipment.

These high-strength steel weldments, now in volume production, are but one of the current structures programs at Rohr.

ROHR
AIRCRAFT CORPORATION

Main Plant and Headquarters: Chula Vista, California; Plant: Riverside, California; Assembly Plants: Winder, Georgia; Auburn, Washington

ULTIMATE capacity of Aero Design's Tulakes Airport plant is estimated in the range of 50-60 aircraft a month on three-shift basis.

ing. Janitrol gasoline heater is the heating element in the system. All these components are integrated by a Barber-Colman control system. A micropulse unit maintains a selected cabin temperature during either supercharger or ram air operation.

Two Pressure Systems

Cabin pressure is controlled by two independent systems, one of them an emergency system for safe operation. With the Alti-Cruiser system, pressurization and air conditioning can be scheduled and operated automatically, although automatic controls can be overriden. When the cabin altitude is selected, an indicator shows the maximum aircraft altitude under which the cabin altitude can be maintained. Rate of pressure change can be set anywhere up to 2,000 fpm.

Air conditioning cycle has four combinations. Flight automatic position means automatic operation of the whole system, and ram air position indicates automatic in-flight heater operation without pressurization. Two other positions are for supercharger operation of cooling and heating systems on the ground. Master switch provides positive control over system. The cabin cannot be pressurized when the switch is in "de-pressurized" position. Moving the switch to "pressurize" puts the system under the schedule preset on the cabin pressure controller.

System includes a de-fog switch for control of evaporation on cabin windows and a separate switch to energize the heater system for automatic control or to shut it off.

Aero Commander's slab-sided fuselage was beefed up to handle the added stresses of pressurization. Gage of cabin frames was increased, and pressure bulkheads were installed fore and aft in the cabin. Six bayonet latches and two hinges secure the door, and the cabin has double windows. Pressurization cost the airplane its emergency escape hatch. There is no change in center of gravity.

Alti-Cruiser is equipped with a new instrument panel. Pilot and copilot panels contain identical sets of flight instruments, although the pilot's set is electrically driven and the copilot's instruments are vacuum operated. Center panel contains engine instruments and the airplane is equipped with a new airline-type control quadrant.

Three radio packages will be offered. Available now is the Wilcox Canari system, and Bendix and Collins packages will be supplied when they are available.

To cut drag, the VHF antenna has been incorporated in a vertical fin cap and omni antennas are in the wing tips. Glide slope antenna is in the nose. These modifications may have improved performance somewhat, although no measurement has been made.

Double-Pane Windshield

Alti-Cruiser has a double-pane windshield with heat pumped between the panes for efficient defrosting, and there is a hydraulically driven wiper on the pilot's side. Along with the pressurization system, the Alti-Cruiser will also have individual outlet emergency oxygen systems with a 22-cu. ft. capacity.

The new airplane will have contoured reclining seats. These new seats have padded armrests which can be folded into the back of the seat when they are in the way.

Lifetime Battery

Alti-Cruiser will be equipped with a lifetime nickel-cadmium battery. Radio pack will cut into baggage space, costing about 25% of the baggage capacity of the 680.

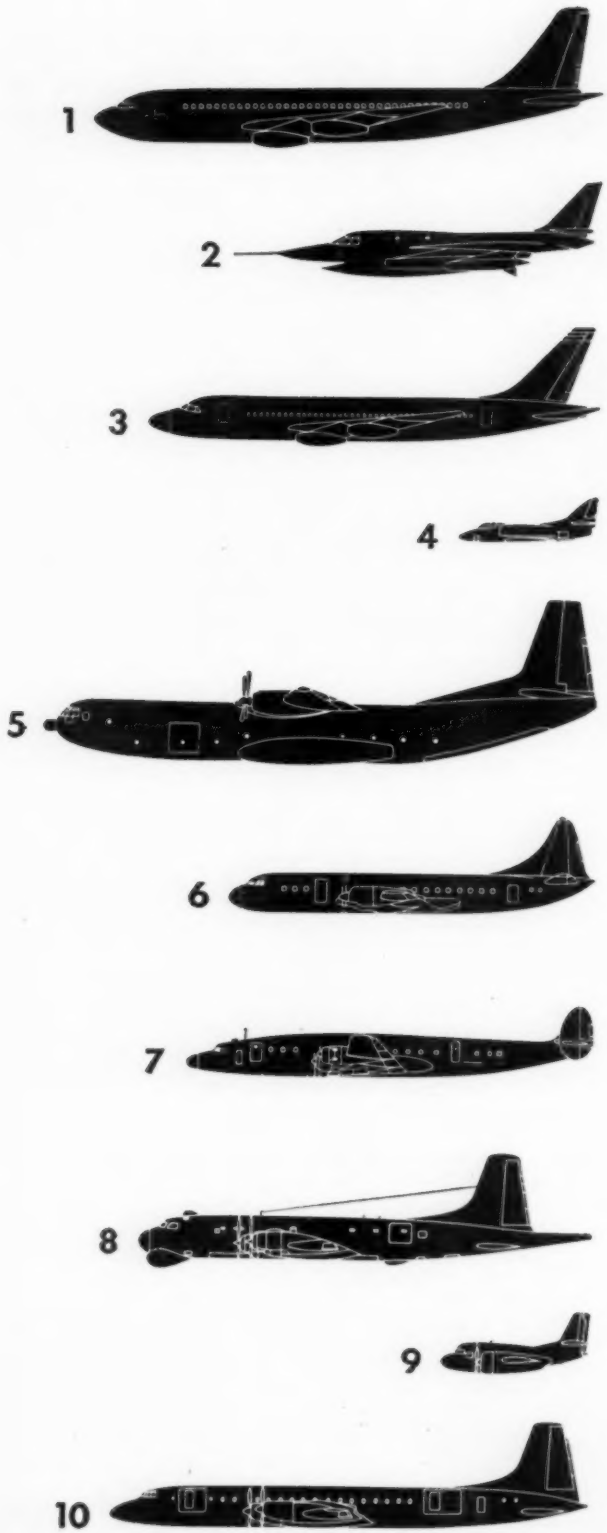
Various other improvements have been made including retractable landing lights in the wings and modification of cabin and baggage compartment lighting.

Alti-Cruiser will be equipped with a rotating beacon.

New airplane will be handled by Aero Design distributors under a slightly different agreement with the factory. Distributors will have to send pilot and maintenance personnel to the factory for special training, and they will have to maintain a factory approved Alti-Cruiser service station.

Distributors will also require that purchasers send a pilot, who must have a commercial pilot ticket with multi-engine land rating, to Aero Design for special training. Distributors of current model 560E and 680 Commanders who don't meet these rules will not be recognized as Alti-Cruiser dealers.

New organizational trends at Aero Design which began under recommendations of Ernst and Ernst, management consultants (AW Mar. 11, p. 97) have continued through 1957. Sales department was the first target for reorganization. R. J. White took over as vice president and director of sales, and the



Can you identify them?

Know what they all have in common?

The aircraft shown here form the vanguard of the wondrous new era of commercial and military aviation. Differing in size, design and purpose, these airplanes have one significant feature in common. All are equipped with Bendix Automatic Flight Control Systems. And that should be proof beyond question that Bendix Automatic Flight Control Systems are the best answer to aviation's needs of today—and the future.

1. Boeing 707—America's First Commercial Jet Airliner; **2.** Convair B-58 (USAF)—America's First Supersonic Bomber; **3.** Convair 880—High-speed, Short- and Intermediate-range Jet Airliner; **4.** Douglas A4D-2 Version (USN)—World's Smallest Jet Atomic Bomber; **5.** Douglas C-133A (USAF)—Largest Operational Prop-jet Transport; **6.** Lockheed Electra—First American-made Commercial Prop-jet Airliner; **7.** Lockheed 1649A—World's Longest-range Commercial Airliner; **8.** Canadair CL-28 (RCAF)—Canada's Largest Submarine Hunter and Killer; **9.** DeHaviland-built CS2F-1 (RCN)—Carrier-based Anti-submarine Airplane; **10.** Canadair CL-44—RCAF's Newest, Long-range, Strategic Prop-jet Transport.

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sales department was expanded.

Tom Harris, former director of freight sales for American Airlines, was appointed director of marketing for Aero Design last summer. Under the new setup, Harris heads a marketing committee which includes the commercial sales manager, military sales manager and director of advertising and public relations. This committee coordinates sales efforts.

Naming of Gene Charles as commercial sales manager in June headed the list of new sales appointments. At the same time, John W. Laister came in as vice president of operations to take over the production program.

Last fall, one of the original backers of Aero Design, R. T. Ais, resigned as president, and that position was taken over by George T. Pew, chairman of the board and a major stockholder.

Production Facility

Fire destroyed Aero Design's main production facility at nearby Tulakes Airport late in August. A new plant was already under construction at Tulakes at the time, and the firm began a gradual buildup of production in the new facility almost immediately. The new plant is now finished, and the first Aero Commander was completed in December. Laister estimates that the new factory has an ultimate capacity in the range of 50-60 aircraft a month.

Discussing sales prospects for 1958, Harris said that there is no reason to believe current business softness will depress aircraft sales. He said that the economic indicators important to the sale of executive aircraft still look good. Harris discussed a new, more positive sales approach adopted by Aero Design called time travel analysis, and he urged distributors to adopt it as a means of showing businessmen that owning their own transport can be a prudent investment and can increase profits.

This technique starts with a determination of the value of a company's executives' time. Then a survey is done to plot the commercial travel pattern of executives, determining length of haul, number who usually travel together and other factors. Aero Design then overlays a picture of what an executive aircraft could do for a company in comparison to its current pattern. And a profitability graph can take this basic data and show what an executive aircraft can do under any given set of conditions.

Commercial Sales Manager Charles told distributors that a bad spares situation caused by the fire has been improved by a complete reorganization of the spares department on an independent basis. A new staff now concentrates specifically on spares problems, and the company no longer uses a common parts supply for both production parts and spares.

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Competition Increases in Helicopter Field

Ft. Worth—Signs of increasing competition among manufacturers for helicopter operator business were evident last week at the tenth annual National Convention of the Helicopter Assn. of America.

Indications of the coming age of turbine helicopter operations were also seen in the vigorous sales effort Republic Aviation is putting behind its Alouette 2, although it was evident that widespread use of turbine-powered helicopters is still several years away.

Operators heard seven manufacturers discuss current and future helicopters. Many of the new commercial machines represent fresh competition and offer operators a choice of helicopters for the first time in some categories.

Republic's Alouette 2 was a center of attraction at the meeting. The company sent a large delegation to back up flight demonstration given during the three-day meeting.

Selling Under License

Republic is selling the Alouette 2 under a licensing agreement with the manufacturer, Sud-Aviation. The aircraft will be built in France and shipped to the U. S. Republic is offering immediate deliveries, and the price is $88,665.

Bell Helicopter Corp. continues to offer the Model 47 series. The Model 47J and 47G-2 are the current production versions. For the "close future," Domestic Commercial Sales Manager Fred Roscoe said that Bell hopes to offer operators a commercial version of the turbine-powered H-40, and he suggested that a convertiplane might be a prospect in the more distant future.

Helicopter Assn. of America delegates toured the nearby Bell plant during the meeting and saw development work being done on the Bell-Bendix-Decca instrument flight system and on a new flight simulator developed by Bell. A key point in the tour was a flight demonstration of the XH-40 for which Bell is expecting a military production contract in the near future.

Another trend evident at the meeting was the expansion of manufacturers' sales programs. Roscoe described the new Bell sales organization (AW Dec. 16, p. 121) and urged operators to make use of Bell sales facilities in working on their own contract prospects. Other manufacturers told of similar expansions in their sales organizations.

Cessna has not yet decided whether it will market its CH-1 helicopter although a decision should be announced within the next few months. Cessna has built a small number of the machines for the Army, and they are now being evaluated at Ft. Rucker.

When Cessna has some results of these tests available, the company will make a decision. No price has been announced, but it "will be a competitive cost helicopter."

Hiller Helicopters is now building the H-12C with a 210 hp. Franklin engine, and the company will market a new model, the H-12D-1, later in the year. It will have the same drive system as the military H-23D, but it will be powered by a derated 360 hp. engine. First delivery is scheduled for October.

New Hiller is expected to cruise at about 87 kt. and have a range of at least 150 mi. Sea level rate of climb will be at least 1,350 fpm. and hovering ceiling in ground effect will be between 9,200 and 10,200 ft. Cost of the H-12D-1 was not announced, but it was described as "competitive for its type."

Hiller also described its Rotorcycle to the operator group and asked for suggestions on how the one-man helicopter might be adapted to commercial operations.

Doman Helicopters' representative discussed his company's present eight-place production model. He pointed out that the machine has a 400 hp. engine and a 5,200 lb. gross weight, observing that it has a low power rating for its weight. Doman built the helicopter around a simplified rotor system, and the company's aim has been to produce a lighter weight, less complex, more easily maintained machine in an effort to keep operating costs low.

Doman feels that the tactical military requirements which now dominate helicopter design will give away to economic considerations as commercial use outstrips military use in the 1960-1965 period.

Sikorsky S-62

In the heavier helicopter category, Sikorsky Aircraft Div. of United Aircraft Corp. described the S-62, a turbine powered version of the S-55.

This S-62 will use about 85% of the S-55's components, but it will have a new transmission system to handle the turbine engine. It will also have a sealed hull and retractable gear to make it amphibious (AW Jan. 20, p. 96).

The S-62 will be available whenever the T53 or T58 engines are certificated and ready—probably about two years from now. Price will probably be higher than the S-55 price by the

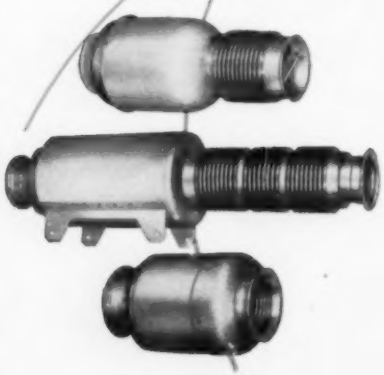
Red Chinese Build First Civil Aircraft

Communist China's first civil aircraft is photographed at rollout. The An-2 is said to be capable of spraying, aerial photographic work and training pilots. Aircraft capacity is 10 passengers or 2,600 lb. of cargo.

113 pounds cut from the Lockheed C-130!

PRESSURE COMPENSATOR, *or compensating bellows, utilizes internal duct pressure to create a force in a sealed chamber equal and opposite to the axial tension. It maintains a transfer of axial tension across the joint while leaving it free to absorb thermal expansion and 5° of deflection.*

"Balanced tension" duct system uses pressure compensator built by Arrowhead



THE BLEED AIR DUCTING SYSTEM of the C-130 is a network of stainless steel tubing varying in diameter from 1½" to 4". It performs eleven functions including heating, air conditioning, de-icing and pressurizing. Using three compressor sources, the air ranges from 360°F. at 35 psig to 670°F. at 145 psig.

With the ducting at an operating temperature of 670° the expansion factor is .00718 for each inch of direct length. Pressure compensators were used to absorb up to 1.8 inches of growth in key locations in the 220-foot ducting system caused by the differential thermal expansion between the ducting and the supporting aircraft structure.

This system, called a "balanced tension system," greatly reduced the number, weight and complexity of ducting supports and allowed reduction in the gauge of duct walls. On the Lockheed C-130, this system actually saved 113 pounds.

For a more complete description of the system write for the new pamphlet, "Design Engineering a Balanced Tension Ducting System for the Lockheed C-130."

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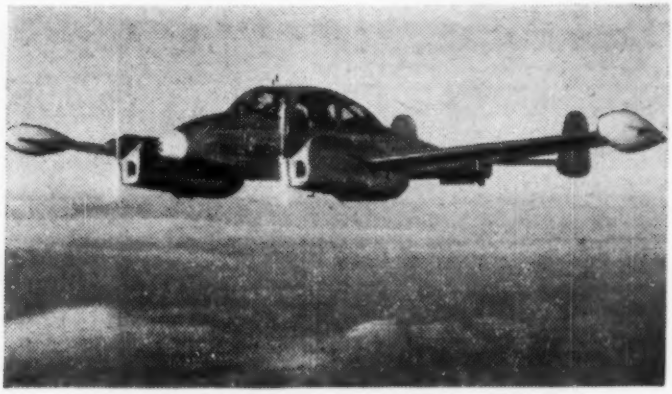

Czech Lightplane Flight Tested

Czechoslovakia's Morava L-200 light transport, currently undergoing flight test, has 40.3 ft. wingspan, 27.6 ft. length, 7.5 ft. height, 4,070 lb. gross weight, 186 mph. maximum speed, 161 mph. cruise speed at 6,560 ft., 994 mi. range, 18,040 ft. ceiling. Engines are rated at 160 hp. each.

difference in cost between the reciprocating and turbine powerplants.

Sikorsky is also working on the S-61 which is described as a twin turbine machine "with considerable seating and with good transport application." It also has a flying boat hull.

Current Sikorsky machines in production are the S-55 and S-58. Last week it was announced that the certificated gross weight of the S-58 has been increased from 12,700 to 13,000 lb. A different fan design released 30-40 hp. formerly used for cooling and permitted a 300 lb. increase in payload.

Significant operational breakthroughs for heavier helicopters were cited by Sikorsky as promoting new markets. These were the successful airlift of a drilling rig into the jungles of Papua, proving the utility of the helicopter to the oil industry, and the construction of transmission lines in southern California (AW Nov. 4, p. 122), opening up another new area of operation.

Vertol Aircraft entered the commercial field last April with the Model 42. Several modifications are in the certification process, and the improved helicopter will be marketed as the Model 44.

First order came from the Swedish navy, and deliveries begin this month on the four Swedish machines.

Turbine Modification

Vertol has modified two of its helicopters to use the T58 turbine engine and one for the T53. Development work is being done on these configurations and the Model 44 is being sold as a machine that can be easily retrofitted to turbine power when the engines become available. In the near future, Vertol expects to announce another twin turbine transport helicopter developed with its own money.

Bell announced at the meeting that it has authority to double the overhaul period on its 47G and 47G-2 helicopters, extending the time between overhaul from 600 to 1,200 hr.

Bell has also extended the requirements of the 25 hr. inspection to 50 hr.

Describing the new CAA-approved overhaul period, Bell Service Manager William J. Diehl looked forward to a new era of economical helicopter operations. The move cuts major overhauls in half and contributes to a significant reduction in overhaul costs on the two Bell models.

Heliport Progress

Progress in development of heliports was discussed by Joe Mashman, Bell's research expert on the heliport problem. Mashman described a growing need for definite standards for heliport location and construction, and he told delegates of recent work done by Bell, Aircraft Industries Assn. and CAA to provide definitive literature on the subject.

Bell has produced a handbook of heliport standards and specifications for helicopters in the 3,000 lb. or under weight class. AIA has prepared a more comprehensive design guide covering all classes of helicopter and it will be shown to the CAA and Civil Aeronautics Board. Mashman pointed out that if CAA concurs with the findings in the AIA design guide, any heliport set up under the guide's specifications would have CAA blessing.

Work is also being done with the Urban Land Institute so that city planners will have the background on heliports necessary to insure that future community plans will include provisions for them.

Mashman noted that the standards included in the guide are rather conservative, but he pointed out that this is necessary to secure CAA approval

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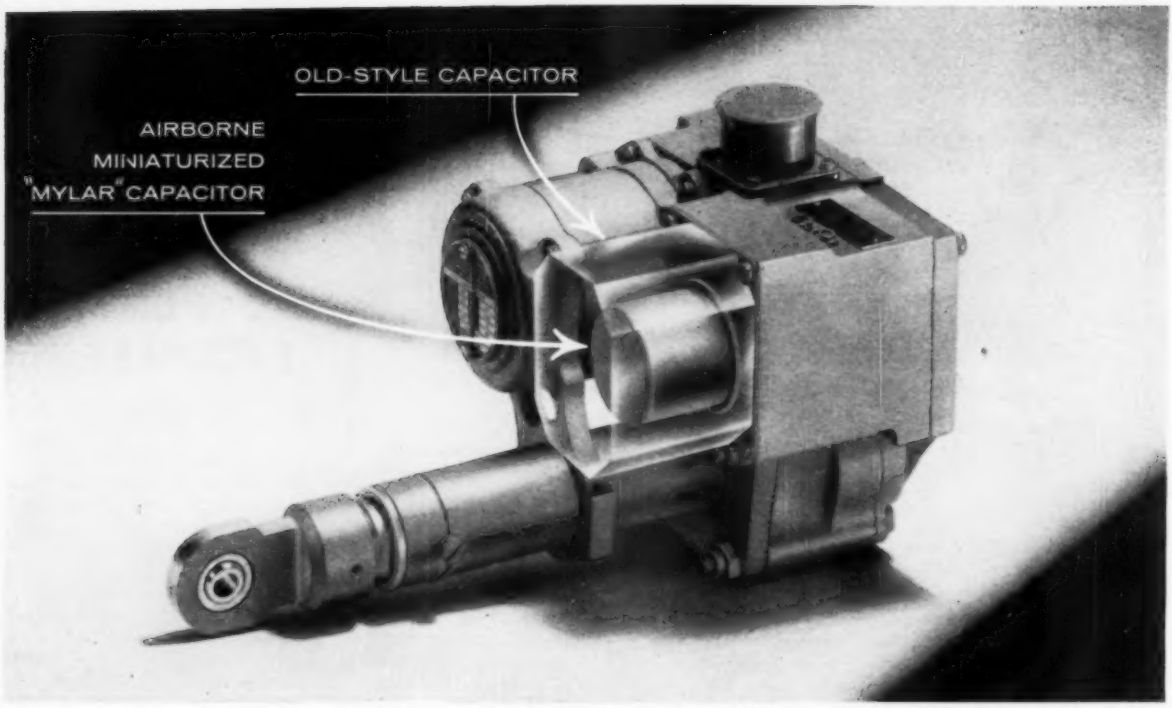

Phantom view shows size of starting capacitor previously used on Model R-1514M1 Airborne Actuator. Change to Airborne-produced, miniaturized "Mylar" capacitor reduced weight of actuator 7.5 oz., increased motor starting torque 1.4 lb./in.

Airborne miniaturized Mylar* capacitor reduces actuator weight ½ lb., increases starting torque 78%

Airborne miniaturized capacitors with "Mylar" film can help you reduce the weight and bulk of many different electrically powered assemblies while actually improving their performance.

In the example above—in this case one of our own actuators—the use of an Airborne miniaturized capacitor cut actuator weight from 6 lb. 5.5 oz. to 5 lb. 14 oz. At the same time, capacitance was increased from 5 to 9.5 mfd and motor starting torque from 1.8 to 3.2 lb./in.

Wound of thin metallized "Mylar" film, Airborne miniaturized capacitors are invariably smaller and lighter than paper/foil capacitors or other common constructions. Yet they have capacitance ratings up to 12 times as high as ordinary capacitors of comparable size and weight. Dielectric strength is also greater because of the superior insulating qualities of "Mylar."

Airborne miniaturized capacitors are rated 200 v d-c and have an operating temperature range of −75°F to +300°F with only 12% capacitance change. At 300°F they will withstand 150% rated voltage for 250 hr. through a resistance of 1 ohm per volt.

Standard design capacitors meet specification MIL-C-25A and are available with three terminal options. Special design capacitors are made to your requirements and meet specifications JAN-C-25, MIL-1-6181B and MIL-M-8609.

Write, phone or wire for more information and quotations.

Airborne Standard Miniaturized "Mylar" Capacitors—200 v d-c

Microf. ±10%	Dia.	Length
.25	3/8	1-1/4
.5	1/2	1-1/4
1.0	5/8	1-1/4
3.0	7/8	1-1/8
4.0	1	1-1/8
5.0	1-5/32	1-1/8
6.0	1-1/4	1-1/8
7.0	1-5/16	1-1/8
8.0	1-29/64	1-1/8
9.0	1-1/2	1-1/8
.17	3/8	3/4
.4	1/2	3/4
.7	5/8	3/4
1.5	1	3/4
18.0	1-3/4	2-1/4

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NEW CATALOG 57B

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and to insure a good margin of safety. CAA is producing its own set of design criteria, but they will be confined to heliports for scheduled operations.

In its business session, HAA decided to set up a study group to explore means of handling general association business. Result may be establishment of a national office and appointment of an executive secretary, or if this is not economically feasible, some alternate means will be proposed to handle common operator problems and give the operators a united public voice.

Delegates elected Richard D. Eccles, Stockton Helicopters, president of HAA for the current year. Ralph Beathe was elected secretary and Robert Trimble is the new HAA treasurer. Next convention will be sponsored by Hiller and will convene somewhere in the San Francisco area.

Cessna 1957 Sales Top $70 Million

A 32% jump in military sales volume last year boosted Cessna Aircraft Co.'s sales volume in 1957 to $70,049,431, giving the company a 6% increase in total sales volume over 1956.

Commercial aircraft sales dipped 13% in 1957 compared to 1956's record-breaking year for a total of $32,628,000. Cessna president Dwane L. Wallace indicated that company's dealers and distributors attained above-normal inventories as a result of 1956's record production which influenced their orders in 1957.

He noted that inventories have been pared well below normal and expectations are that 1958 business aircraft sales will be substantially higher than 1957. Increased orders for the light twin Model 310 and introduction of the new Model 175 in 1958 will tend to spur increased dollar volume for Cessna this year, Wallace reported.

Cessna reports that its orders for 310s through March are 25% higher than the same period in 1957.

Massive mail campaign is planned by the company this year to build new sales volume. Highlight will be direct mailings to 20,000 presidents of U.S. corporations.

Military prime and subcontract sales totaled $32,476,000 in 1957 and sales of the Hydraulic Div. increased 22% over 1956 to $4,830,000. Major factors in boosting military sales last year were increased rate of T-37A and L-19 production and deliveries of the L-27A, military version of the 310.

Military sales are expected to at least equal 1957 volume. Backlog as of Dec. 1 totaled $50,300,000 and is expected to climb to over $60 million soon.

Cessna's export sales climbed 49% last year compared to 1956 and ac-

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Offering the most complete combination of chemicals, equipment and services, DETREX can properly recommend, engineer and service the proper, specific application.

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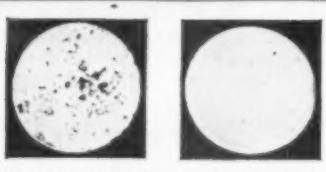

Photomacrographs show results of DETREX Sonicleaning. Left panel shows .0250 grams of soil left after previous cleaning. Right, only .0002 grams remain after DETREX Sonicleaning.

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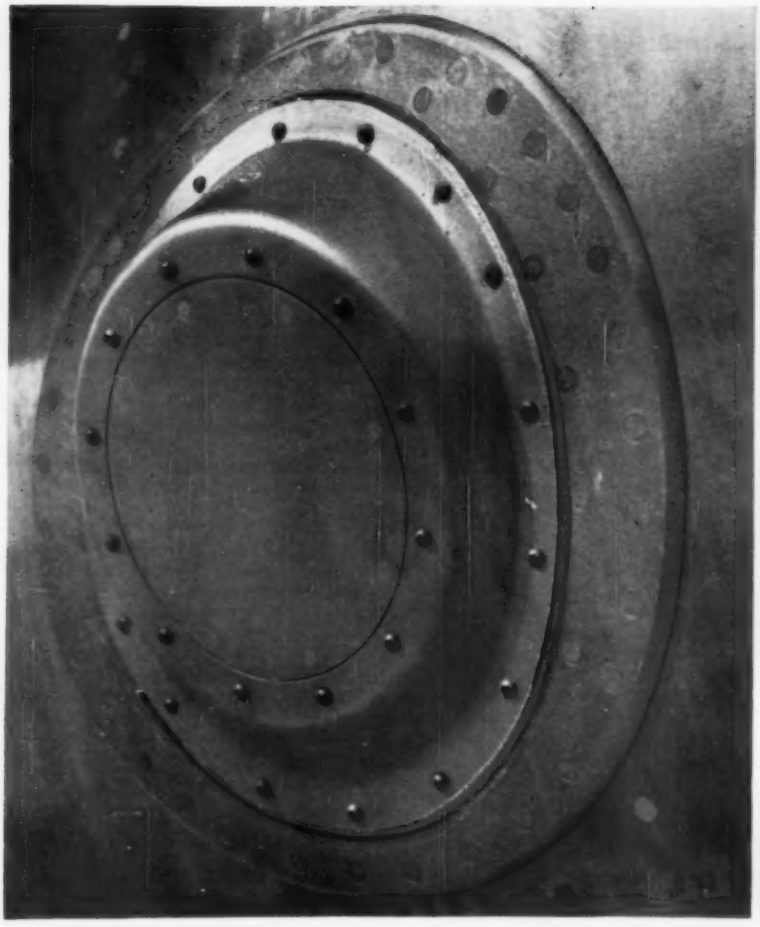
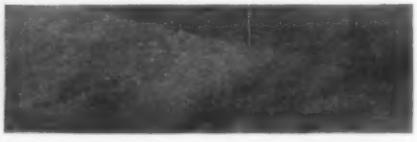


The Boeing B-47 Stratojet medium bomber uses many Silastic parts. Among these is the antenna cover gasket shown here, which must stay rubbery despite the frigid slipstream at high altitudes.



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Beech Forecasts Major Sales Gain

Sales of more than $95 million are predicted by Beech Aircraft Corp., Wichita, Kans., a gain of 24% over the average of total sales in 1954 through 1956.

Commercial aircraft sales are expected to total more than $39 million in the current fiscal year compared to $35,746,094 attained in Fiscal 1957. Military sales in the present fiscal year are expected to decline to some $56 million, compared to Fiscal 1957's $68,158,776, but will be over Fiscal 1956's $42,447,178. First fiscal quarter sales, for period ending Dec. 31, 1957, came to $20,783,988, up slightly over the same period last year which totaled $20,244,370.

Combined military and commercial backlog as of Jan. 1 totaled more than $96 million.

counted for 22.5% of the firm's commercial deliveries. Total of 511 planes were sent to 33 different countries last year, a large share to Central and South America, where it has been concentrating its export sales. Company plans to increase sales efforts in other world areas soon, Wallace stated.

Aerocar Developing Plane-Only Version

Aerocar, Inc., Longview, Wash., is developing a "plane-only" version of its Civil Aeronautics Administration-approved flying automobile.

New version, some 360 lb. lighter than the original dual-purpose configuration, will retain folding wings feature and will be able to carry four people in place of two in the Aerocar. New model will require Type Certification. Prototype is expected to start its flight test program in March.

Five flying automobile type Aerocars have been built and are operated by the manufacturer. Price of these units is $25,000.

PRIVATE LINES

Aircraft showroom, capable of displaying three business planes, is being built by Blackfield Aero Industries, Metropolitan Oakland International Airport, Piper sales and service dealer.

Bell Model 47G and 47G-2 helicopters are authorized by Civil Aeronautics Administration to fly 1,200 hr. between major overhaul. Previously, the period was 600 hr. Also, helicopters' 25-hr. inspection has been extended from 25 hr. to 50 hr.

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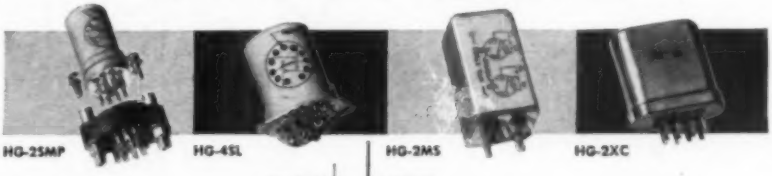

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THE NEW X-13 VERTIJET is another example of the technical break-throughs Ryan is achieving in aviation. You'll find the same high level of advanced engineering in every phase of Ryan's work:

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- **Rocket Combustion**
- **Jet Engine Metallurgy**
- **Drone-Missile Design**

Ryan is the right size for you: big enough for complete responsibility on challenging projects... small enough so you won't get lost in the shuffle. And Ryan is located in clear-sky San Diego, world-famous for beaches and casual living.

For complete details, write to JAMES KERNS

RYAN AERONAUTICAL COMPANY

2740 Harbor Drive, San Diego 12, California

EMPLOYMENT OPPORTUNITIES

NATIONAL COVERAGE

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant | **Civil Service Opportunities** | **Employment Agencies**
Positions Wanted | **Selling Opportunities Wanted** | **Employment Services**
Part Time Work | **Selling Opportunities Offered** | **Labor Bureaus**

DISPLAYED

The advertising rate is $37.40 per inch for all advertising appearing on other than a contract basis. Frequency rates quoted on request.

An Advertising inch is measured ⅞" vertically on a column—3 columns—30 inches to a page.

Subject to Agency Commission.

——RATES——

UNDISPLAYED

$2.10 per line, minimum 3 lines. To figure advance payment count 5 average words as a line.
Position Wanted Ads are ½ of above rate.
Box Numbers—counts as 1 line.
Discount of 10% if full payment is made in advance for 4 consecutive insertions.
Not subject to Agency Commission.

Send NEW ADS to Classified Advertising Div. of AVIATION WEEK, P. O. Box 12, N. Y. 36, N. Y.

THE CARDS won't tell your engineering future

We recommend a look at General Electric's Small Aircraft Engine Department. You see a clear consistent record of growth and achievement.

In four years, SAED engineers won development contracts for the T58 turboshaft, J85 turbojet, T64 "convertible". . . introduced a constant speed control concept for helicopters . . . achieved 3:1 and better power-weight ratios . . . determined the feasibility of one basic power section for turboshaft and turboprop applications.

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FAR-SIGHTED ENGINEERS IGNORE THE CARDS . . . LOOK INSTEAD TO A HISTORY OF GROWTH AND ACHIEVEMENT.

IF YOUR EYES ARE ON THE YEARS AHEAD, WRITE US IN CONFIDENCE TODAY.

MR. WILLIAM MERRILL, TECHNICAL RECRUITING
SMALL AIRCRAFT ENGINE DEPARTMENT
GENERAL ELECTRIC
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We are looking for a graduate M.E. or E.E. who has experience in selling technical products to the aircraft and missile industries. Maintaining close liaison with customers engineers requires traveling.

Salary is open. Excellent supplementary benefits and liberal profit sharing program. Please submit complete resume including salary requirements to:

BOX 608, 1501 BROADWAY, NEW YORK 36, N. Y.

When Answering BOX NUMERS . . .

to expedite the handling of your correspondence and avoid confusion, please do not address a single reply to more than one individual box number. Be sure to address separate replies for each advertisement.

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This man will handle a Minneapolis home office territory himself and supervise field sales engineers. Responsibilities include forecasting, budgeting, approval of advertising. Opportunity is just right for a successful sales engineer ready for more responsibility.

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SESSIONS ENGINEERING COMPANY
(for client)
Management Consultants
1562 Northwestern Bank Bldg.
Minneapolis, Minnesota

Sales Engineers

VICKERS INCORPORATED

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Engineering degree—Age 28-45. Five to ten years experience with missiles or missile systems in the engineering or sales field.

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VICKERS INCORPORATED

Administrative & Engineering Center
P. O. Box 302, DETROIT 32, MICH.

Address replies to:
R. E. Barlow, Manager of Employment

FOR RATES OR INFORMATION

About Classified Advertising

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BOSTON, 16—350 Park Square
J. WARTH — *HUbbard 2-7160*

CHICAGO, 11—520 No. Michigan Ave.
W. HIGGENS — *MOhawk 4-5800*

CINCINNATI, 37—2005 Seymour Ave.
F. ROBERTS — *Elmhurst 1-4150*

CLEVELAND, 13—1164 Illuminating Bldg.
W. SULLIVAN — *SUperior 1-7000*

DALLAS, 2—1712 Commerce St., Vaughn Bldg.
G. MILLER — *RIverside 7-5117*

DETROIT, 26—856 Penobscot Bldg.
J. GRANT — *WOodward 2-1793*

LOS ANGELES, 17—1125 W. 6 St.
R. YOCOM — *MAdison 6-9351*

NEW YORK, 63—500 Fifth Ave.
R. OBENOUR — D. COSTER — R. LAWLESS
OXford 5-5959

PHILADELPHIA, 3—17th & Sansom St.
H. BOZARTH — R. EDSALL
RIttenhouse 6-0670

ST. LOUIS, 8—3615 Olive St.
F. HOLLAND — *JEfferson 5-4867*

SAN FRANCISCO, 4—68 Post St.
W. WOOLSTON — *DOuglas 2-4600*

Engineer or Scientist

COPY—CONTACT TECHNICAL FIELD

for 4A Advertising Agency

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Write, stating degree and full details of experience to:

P-7125—Aviation Week
Class. Adv. Div., P. O. Box 12, N. Y. 36, N. Y.

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VISUAL TRAINING

OF COMMERCIAL AIR LINE PILOTS

To Meet Eyesight Requirements of Periodic Company and C.A.A. Exams

DR. JOHN T. FLYNN

OPTOMETRIST - ORTHOPTIST

Visual Training Specialist

300 W. 23rd St., New York City

By Appointment Only WA. 9-5919

REPLIES (Box No.): Address to office nearest you c/o This publication Classified Adv. Div.
NEW YORK: P. O. Box 12 (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS WANTED

Field Service Engineer-Degree. Experienced in Gas Turbine Reciprocating engines, Fuel Controls & acft. accessories. Military & Commercial contacts Seattle-San Diego. Pioneering Sales. PW-7022, Aviation Week.

Field Engineer. 7 years electronics, electro-mechanical; 4 in field service: 1 in digital, 2½ in analog. Overseas experience. PW-7072, Aviation Week.

Airline Captain 33, C-46 rated. 3600 hrs. experienced international, domestic. DC-6, DC-4, DC-3, light aircraft, available immediately, will travel. PW-7050, Aviation Week.

Comm. Pilot. H'Copter 3500 all types. Fixed Wing 6800 DC-4, DC-3, Twin Beech. SMEL-SMES, Inst., H'Copter, H'Copter Instruct. 35, Married. Seek permanency. Excellent References. Full info on request. PW-7100, Aviation Week.

Missile & Aircraft Field operation manager. 7 years experience in missile research & development. Qualified as engineering test pilot. 6000 flying hours. Over 1000 hours engineering test flying in fighter & bomber jets. Extensive experience in all phases of missile flight operations. Will consider any appropriate position. PW-7099, Aviation Week.

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DON'T FORGET

the box number when answering advertisements. It is the only way we can identify the advertiser to whom you are writing.

CLASSIFIED **SEARCHLIGHT SECTION** ADVERTISING

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

DISPLAYED RATES UNDISPLAYED

The advertising rate is $24.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

Closing date is 11 days before issue date, subject to space limitations.

$2.10 a line, minimum 3 lines. To figure advance payment count 5 average words as a line.

BOX NUMBERS count as one line additional in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads.

Send new ads to Classified Advertising Div., Aviation Week, P. O. Box 12, New York 36, N. Y.

HILLER HELICOPTERS WANTED:

Well known aviation organization wishes to purchase used

HILLERS
12A
B
and
C
HELICOPTERS

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26 passenger ex-Eastern Wright G202A

DC-3

Full airline equipment

$100,000.00

TRADE-AYER CO.
Linden Airport, Linden, N. J.
Wabash 5-3000

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Call or write —

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Murray Hill 7-2050

FOR IMMEDIATE SALE

An Exceptional

DC-3

Fully Equipped
And Modernized

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Immediate Delivery

We stock, overhaul, and install

PRATT & WHITNEY	WRIGHT
R1830	**R1820**
–75, –92, –94	–202, –56, –72

R985 R1340 R2000

and our most popular DC3 engine
R1830 - SUPER - 92

ENGINE WORKS INC.

Lambert Field Inc. St. Louis, Mo.

WANTED

TWIN BEECH D-18C

Low time Continental Engines. Advise full specifications and best price.

ATLANTIC AVIATION CORP.
Logan Airport, E. Boston, Mass.
Phone LOgan 7-8700

FOR SALE

DC-4E

Overwater Configuration
Convertible
Passenger-Equipped

Zero-Time Engines and Airframe if Desired

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California

Tel: LOckhaven 2-2247
TWX: OA-432
Cable: ONATAIR, OAKLAND

WORLD'S LARGEST INVENTORY

C-82 PARTS

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BETTER C-82's

ONLY AAF Overhauled models available on the market. Stored in ideal climate. 10 day delivery with fresh control surfaces.

STEWARD-DAVIS, INC.
FA 1-3414, P.O. Box 351, Gardena, Cal.

LEASE OR SALE

DC-4 E

Long range fuel system, convertible interior, 80 seats on track, low time on engines & airframe. Foreign inquiries invited, financing available.

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P. O. Box 184, Miami 48, Fla.
Cable: Airland Phone: Newton 5-0734

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Financing Available

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Completely overhauled. P & W —92 engines, payloader seats, winterized, cargo door, heavy gear, airline radio. Foreign inquiries invited.

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CABLE—Airland Newton 5-0734

IMMEDIATE DELIVERY

TWO C46Rs 49,900 lbs
T CATEGORY

TAS 220 mph 21,000 lbs useful
Zero time Cargo interior
Licensed for up to 62 seats
We are the owners

L AND J TRADING COMPANY
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Miami Phone MO 5-3771

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Send $5 for report 58-3X of bids awarded for each of 108 aircraft—T-6G, T-28A, F-51D, C-45G, C-46A, B-25, and B-26 (A-26) —sold at Norton AFB, Calif., Jan. 10, 1958.

AERODATA
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AIRCRAFT FOR SALE
PBY AMPHIBIAN AIRCRAFT

—Surplus to Canadian Exploration Company's use
—Extra Large Cargo Door and Cargo Floor
—Executive Passenger Compartment, Emergency Rocket Power
—Galley Facilities, Survey Turret in Nose
—Aircraft Completely Outfitted for Instrument Conditions and 2 Crew Operation, Extremely Well Maintained and in Excellent Condition.

Available for Immediate Sale at Reasonable Price

FS-2070, Aviation Week
Class. Adv. Div., P.O. Box 12, N.Y. 36, N.Y.

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Super 18—Total time 325 Hours 1957 Model.

D18S—Two available. Completely equipped. Excellent buys at $25,000 & $32,500.

C-50—Twin-Bonanza. 20 Hours since rmf engines. Complete ARC radio. Auto pilot. Many other extras. $55,000.

B-50—Two clean Twin-Bonanzas. Appearance and mechanical condition outstanding. Both with auto pilots. $37,500 & $42,500.

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ATLANTIC AVIATION CORP.
Teterboro Airport, Teterboro, N. J.
ATlas 8-1740

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Deal Directly With Owner

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A. J. Ming Wabash 5-3000
TRADE-AYER COMPANY
Linden Airport, Linden, N. J.

For
SALE - LEASE - PURCHASE FINANCE
by owner

4 C-46F's
with/without T Category

1 DC-3
P & W Engines

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Janitrol Platular* heat exchangers in modular units, reduce weight and increase design freedom.

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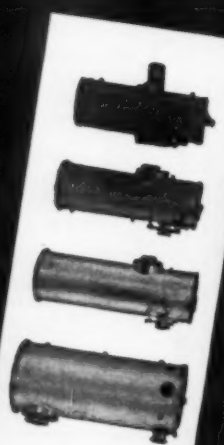

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Janitrol Aircraft Automotive Division,
Surface Combustion Corporation,
Columbus 16, Ohio

Janitrol®

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exceptional opportunities in TECHNICAL COMMUNICATIONS for WRITERS

Missiles, and the weapon systems built around them, constitute a growing, long-range area of opportunity for writers skilled in the practice of technical communications.

High in interest and importance are missile systems designed for the defense of the country. The newest, longest-range defense missile in the Air Force's arsenal is the Bomarc IM-99, now going into production at the Pilotless Aircraft Division of the Boeing Airplane Company. Bomarc weapon system bases are being established and Boeing, in addition, is at work on extremely advanced missile and rocket projects of the future. Since technical communications is an important phase of missile projects at Boeing, there is an urgent need for ENGINEERING TECHNICAL WRITERS to prepare Operation and Maintenance Manuals.

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LETTERS

Engineer Activity

I heartily agree with the viewpoint expressed in the letter entitled "Inactive Engineers" in the Dec. 30 issue of AVIATION WEEK (p. 102). What we need is not more engineers but more and better jobs for the ones we do have.

KENNETH C. OSLUND
Albuquerque, N. M.

Engineer Shortage

Re the letter by James Rarick concerning "Inactive Engineers" (AW Dec. 30, p. 102), I should like to add a few words.

There is not now, nor has there ever been, a real shortage of engineers in this country. Rather, there has been a shortage of managerial ability to use our engineers efficiently.

How and why the shortage fiction continues to exist is incomprehensible in view of the recent news items citing the engineering surplus in Los Angeles, San Francisco, New York City and most of New England.

We Americans have developed a numbers complex. We are driven to match the Russians, output for output, in engineers, technicians and dollar loans, regardless of our needs and desirability for same.

I, for one, certainly hope we don't try to prevent Russia from lending or giving money to the Middle East countries. After all, what better way exists to let the Russians strain their own economy than to get them to support some of the backward countries of the Earth?

Who knows, they might even learn something about helping others from their endeavors?

A. MANDELL
Newton, Mass.

Sad Commentary

The letter entitled "Inactive Engineers" in the Dec. 30 issue (p. 102), addressed to the editor, is not only true but a sad commentary of the facts. The cry for more scientific personnel is invalid since both my engineering positions in civilian and government service have been of a high school level.

RONALD L. BRUCKER
Albuquerque, N. M.

Razzle Dazzle

I have read with sincere sympathy the small "cries in the wilderness" against the overwhelming heap of engineer-shortage propaganda. When your reader, James Rarick, in his letter published in AVIATION WEEK of Dec. 30 (p. 102) appeared, I could not resist his invitation to "stand up and be counted." Please count me!

After having tried two aircraft company employers since 1955, who had little or no need for my services, I have about given up finding the happy satisfaction that comes after a day's sound achievement. We're forever just holding things together, anticipating the "big contract that will give us lots of work." I continue to hang on to aircraft work because of the sizable pay cut that would accompany a transfer to any other field of engineering. Also, I enjoy associating with flying machines.

As for the propaganda, you can easily verify this yourself by answering some of the ads in AVIATION WEEK and other magazines. Some don't even ask for applications, while continuing to advertise for engineers. It is obvious that if a concerted effort on their part will produce a surplus of engineers, they will stand to advantage.

Your publishing such letters as Mr. Rarick's is a selfless service to frustrated engineers, and I selfishly hope that someone will become aware of the razzle dazzle going on right before our eyes before great harm is done. I have never seen such opinions published elsewhere.

ENGINEER
Long Beach, Calif.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Thesis Challenged

The letter from James Rarick, published in the Dec 30 issue of AVIATION WEEK (p. 102) has finally moved me to write. I do not wish to chastise Mr. Rarick or question his opinion, but I do wish to take issue with these people as a general class, who have caused a long series of such letters to be published. All of these seem to be based upon the same theme and it is the thesis that I challenge.

The engineering profession is a hard and exacting mistress who bestows upon her lover favors equal in value to the gifts which he has brought to her. She returns value no more or no less than she receives. If these men who complain in the public press have not given of themselves, then they have no grounds to expect the rich reward that awaits.

The engineer is a professional. He is creative, imaginative, inventive, and he is a thinker. He is a dealer in facts. He is an improver. He is the servant to the environment in which he lives and the science to which he is dedicated. His apprenticeship has been hard. He has suffered defeat, failure and disappointment. He has also tasted the wine of success. His hands are calloused and have been dirtied by his labors. He doesn't have to be told what to do. He knows what must be done, and will find a way to do it. There has been a shortage of such people.

There is now a shortage of such people, and there will always be a shortage far less than our need.

The rest are pretenders and triflers. There is always an oversupply of these. They mention prostitution. There was prostitution. It occurred when these men took their degree and sold their bodies to the highest bidder without regard for their own professional development of their own engineering goals. And now they cry! Because they are not in fact engineers, they blame industry or anyone else but themselves. Their profession is not engineering, but is the oldest profession in the world.

As an engineering supervisor, I know these people. They sit across the interview table from me. None of them work for me. They complain of a lack of interesting and challenging work while the press is full of our technical failures and disappointments. It is not work that they want. It is position and wealth which far outstrips their competency as professional engineers. There is plenty of work to be done by those who will put down their pencils, roll up their sleeves and get their hands dirty serving the apprenticeship they should have served.

I feel no sympathy in my heart for these people. The industry is in desperate need for engineering talent. It will pay an honest wage for engineering value received, but will no longer pay for an inflated ego or a piece of paper that says the bearer is an engineer. If these people cannot qualify under these rules then they had better get off the back of their laps and do something about it. This is a personal thing. Don't blame industry.

CHARLES F. McMORROW
Haddon Hgts., N. J.

In Agreement

With reference to James Rarick's letter in the Dec. 30 issue (p. 102) of your magazine: Please count me as one who is in agreement with him 1,000%.

LAWRENCE L. IZZO
Bridgeport, Conn.

Unrewarding Field

I wish to concur with the timely letter "Inactive Engineers" in the Dec. 30 edition (p. 102). It is, unfortunately, a widespread situation, having been assigned myself to many menial tasks. I have advocated to my brothers and associates not to enter this unrewarding field.

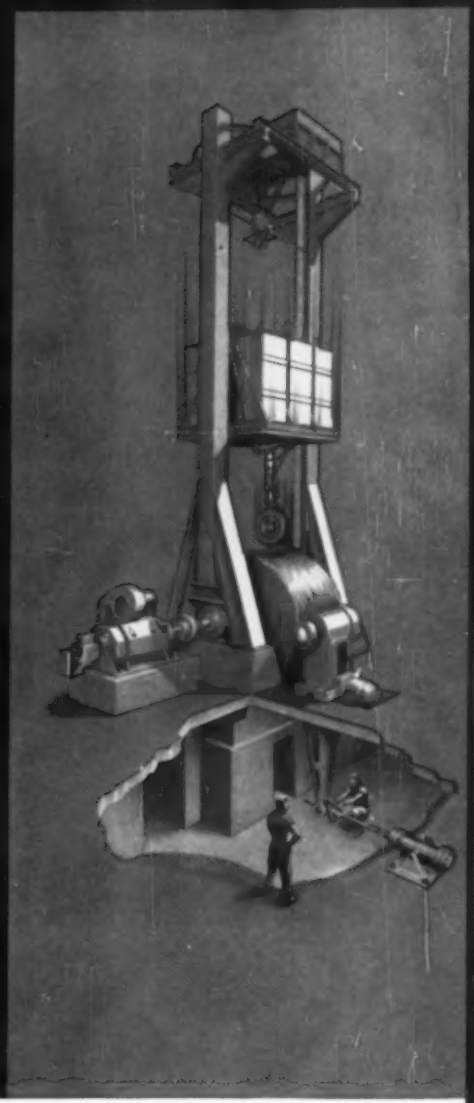
At present in the military service it is almost impossible to do engineering.

TEXAS ENGINEER
Lubbock, Tex.

Waste of Talent

Re the letter "Inactive Engineers" by James Rarick (AW Dec. 30, p. 102), I fully concur with this fellow's views. Industry has been forced into its wasteful use of valuable talent because of its increasing dependence on large government contracts for existence. A close examination of the government's methods of contract awarding should prove fruitful in finding the key for release of some of this "hoarded" talent.

MATHEMATICIAN
Albuquerque, N. M.



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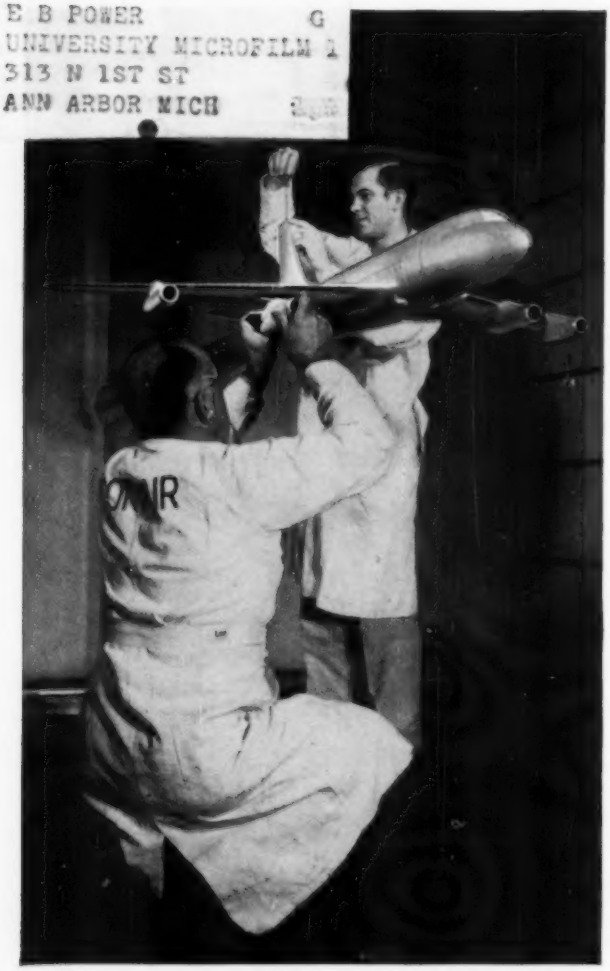

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